
Waste Reduction Program Assessment and Analysis for Massachusetts

Submitted To:

Massachusetts Department of Environmental Protection

Submitted by:

Tellus Institute
11 Arlington Street
Boston, MA 02492

Contact: James Goldstein
jgold@tellus.org

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Waste Reduction Program Assessment and Analysis for Massachusetts

Draft Report

I. Executive Summary

In December 2000, the Department of Environmental Protection (DEP) issued the *Beyond 2000 Solid Waste Master Plan — A Policy Framework*, its plan and vision for managing solid waste over the coming decade. While the *Beyond 2000 Master Plan* applauds the significant waste reduction accomplishments in the decade since the first Master Plan was issued in 1990, including a Municipal Solid Waste (MSW) recycling rate of 38% and recycling services expanded to 85% of the population, it also recognizes the challenges to increasing waste reduction.

The *Beyond 2000 Master Plan* lays out the Department's key long-term goals for solid waste management in the Commonwealth, including reducing the waste produced by 70% through source reduction and recycling (60% MSW waste reduction and 88% Construction and Demolition Debris (C&D) waste reduction); and removing toxics from the waste stream before recycling or disposal by providing universal access to hazardous product collection services by 2010. Although the *Master Plan* demonstrates a clear vision for the Commonwealth's solid waste management and identifies numerous strategies that DEP plans to pursue, it does not attempt to prioritize among the various programs, estimate their respective waste reduction impacts, or assess their relative cost effectiveness. Thus, in May 2002, DEP contracted with Tellus Institute and McKenzie-Mohr Associates to identify the most effective way to invest DEP's grant, education, and technical assistance funds and deploy its staff resources to achieve the solid waste reduction and toxicity reduction goals stated in the *Master Plan*.

This project focuses on what DEP needs to do between now and 2010 to reach the waste reduction goals articulated in the *Master Plan*. The project includes an assessment of the best strategies to reduce waste at its source and increase participation in existing programs. It also identifies the most critical areas to expand recycling and composting access and infrastructure to move toward the 70% waste reduction goal. As such, this report is intended to provide a recommended "roadmap" for reaching this goal, identifying the sectors of the waste stream to target, the additional quantities of waste reduction that can be achieved in each sector, the strategies necessary to achieve these reductions, and the resource allocations required.

Although reaching DEP's overall 70% waste diversion goal by 2010 presents a significant challenge, with aggressive DEP efforts — particularly in increasing overall source reduction and increasing diversion in the commercial sector — and adequate resources, this goal is achievable. Specifically, our analysis indicates that, while total solid waste generation (after source reduction) is anticipated to grow from 12.66 million tons in 2000 to 16.92 million tons in 2010, this growth can be more than offset by aggressive source reduction, recycling, and composting programs.

Our assessment confirms DEP's initial analysis, indicating that the bulk of additional reduction potential is in the commercial sector. This is not surprising, given that commercial waste represents more than half the MSW waste stream, yet the Department's focus to date has been primarily on municipal/residential waste reduction,¹ the sector it can most directly impact. As in many other states, only more recently has DEP expanded its focus to include serious efforts at commercial waste reduction.²

The following summary tables and charts present a snapshot of 2000 and projected 2010 diversion and a summary comparison of recommended expenditures and staffing for 2002, 2006, and 2010. Note that the 2006 and 2010 expenditure levels are not intended to be precise funding recommendations. Rather, they are based on professional judgment and represent the priorities and shifts in funding levels we estimate are necessary to meet the waste reduction levels identified over this period.

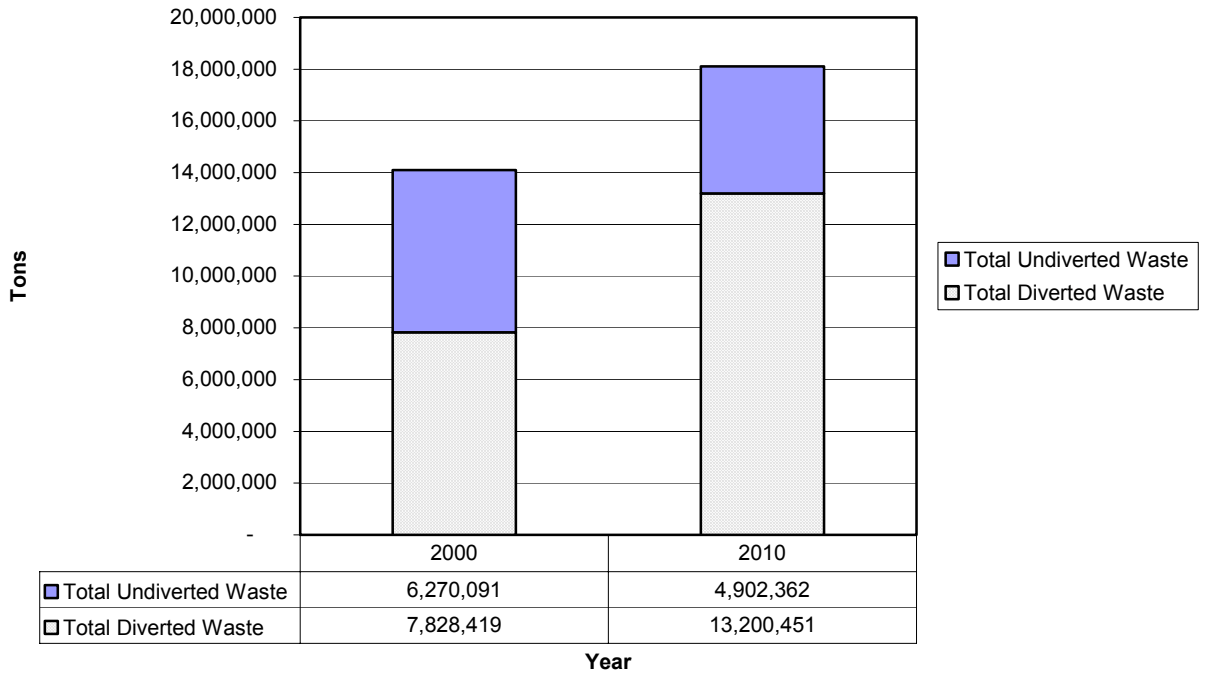
Summary of 2000 and Projected 2010 Total and Additional Diversion (in tons)

	Residential	Commercial	C & D	Total
Estimated Total Diversion 2010	3,446,956	4,097,970	5,655,525	13,200,450
Existing Diversion 2002	1,967,760	1,890,659	3,970,000	7,828,420
Estimated Additional Diversion	1,479,196	2,207,311	1,685,525	5,372,030

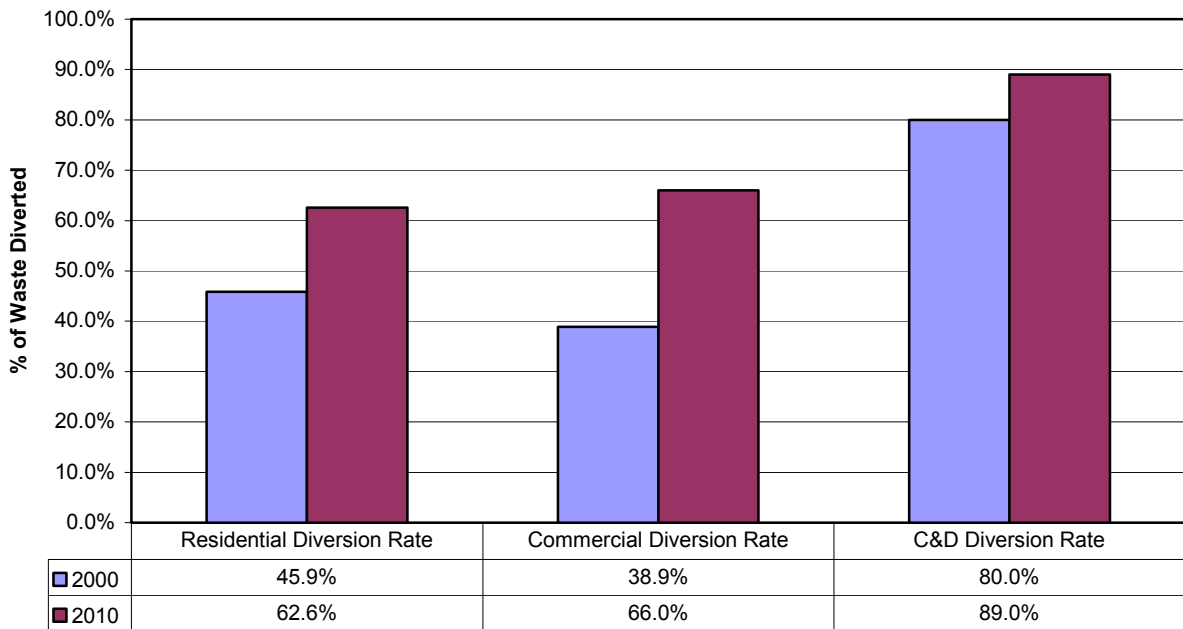
¹ DEP includes residential waste in its "municipal waste" category. For purposes of this report, these terms are used interchangeably, though we use "residential" most frequently.

² Even the February 1999 report developed by the Recycling 2000 Task Force, *Recycle 2000: Recommendations for Increasing Recycling in the Commonwealth of Massachusetts*, considered commercial recycling strategies as "tier 2" opportunities for the longer term.

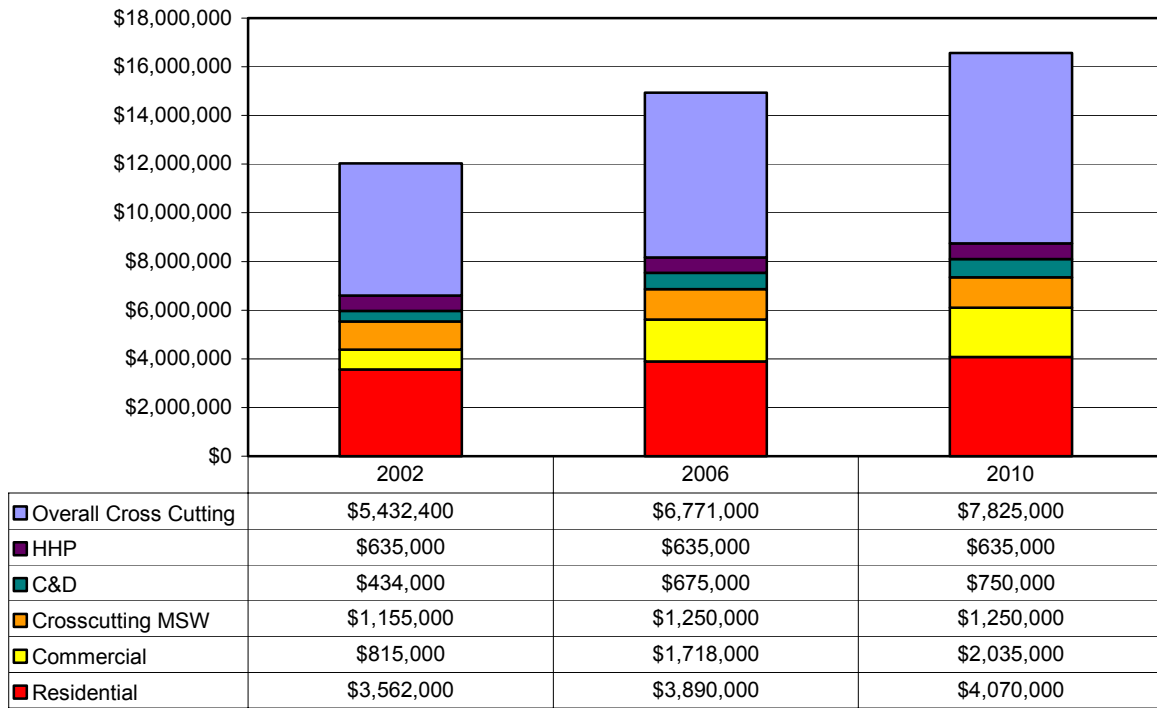
**Waste Disposition 2000 and 2010:
All Sectors**



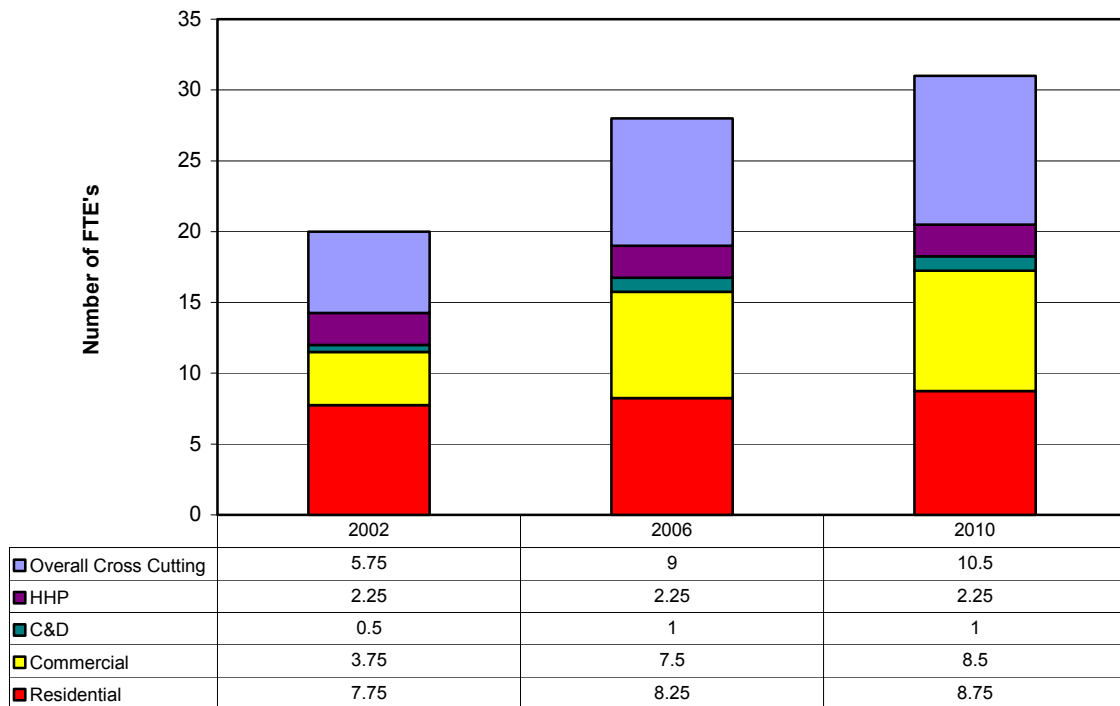
Waste Diversion Rates in 2000 and 2010 by Sector



Expenditures by Sector 2002, 2006, 2010



Staffing by Sector 2002, 2006, and 2010



As discussed below, we concur with DEP's fundamental balanced approach combining financial and technical assistance "carrots" with regulatory "sticks." While the specific tools vary, DEP has recognized and supported the value of establishing solid waste management systems and approaches that provide real incentives for waste reduction and, where appropriate, has done so through market mechanisms rather than regulation. Also, the Department must continue to address the multiple facets of successful waste reduction, including program and infrastructure development, education and technical assistance, and market development.

Because of how various sets of sector-focused and crosscutting tools contribute to waste reduction achievements, and because there are many other factors beyond DEP activity that impact waste reduction, it is difficult to estimate the cost effectiveness of individual DEP tools or strategies. However, if we simply look at the levels of past expenditures and the level of estimated waste reduction to date assumed for the various sectors (see Section III, below), it is clear that DEP has spent more on residential programs on a dollars-per-ton basis than commercial programs. This is not surprising for several reasons. First, when these programs began, a commercial recycling infrastructure was already established, but the residential infrastructure needed to be built. Now that residential waste reduction efforts in the Commonwealth are at a relatively mature stage and, as with most investments aimed at changing behavior, additional progress becomes increasingly difficult and costly as targets go beyond the "low hanging fruit." Second, as noted above, DEP can most directly affect municipal/ residential waste management practices and has therefore expended considerable dollars on infrastructure and equipment. Commercial waste management is largely the responsibility of the private sector, and DEP has appropriately left collection infrastructure and equipment investments to the market.

Looking ahead through 2010, DEP must continue to play a central role in promoting waste reduction activity if the *Beyond 2000 Master Plan* waste reduction goals are to be achieved. Although we cannot attribute specific waste diversion progress to the individual programs, it is clear that in many cases DEP investments of staff time and dollars have directly enabled implementation of a variety of waste reduction programs throughout the Commonwealth. These investments have taken a variety of forms, ranging from technical assistance that provides required staff expertise that is often not available at the municipal level, to equipment grants for recycling or Household Hazardous Product (HHP) collection and/or management, to direct payments under the Municipal Recycling Incentive Program (MRIP), Pay-As-You-Throw (PAYT), or other programs. As discussed below, the interactive and complementary nature of many waste reduction tools and strategies is another complicating factor in assessing optimal resource investment levels/allocations for DEP. Nonetheless, certain conclusions can be drawn from experience to date in Massachusetts and elsewhere.

Primary findings from this analysis include:

- DEP is already implementing a comprehensive set of waste reduction programs that are reasonably well targeted. There are minimal new programs recommended in this report. Rather, our findings and recommendations are aimed at shifting emphasis and better allocation of the Department's resources in order to move certain programs from an

exploratory/pilot or infrastructure development phase, to increasing participation and a program maintenance phase.

- DEP efforts should include both incentives and penalties (i.e., “carrots and sticks”) to encourage waste reduction. Therefore, enhancing enforcement efforts through increased waste inspections and effective follow-up should not be ignored in favor of grant programs or increased MRIP payments. Both are important, and enforcement encourages other waste reduction practices.
- Given that residential waste reduction efforts are reaching maturity in terms of collection infrastructure, and that it would be inappropriate for DEP to directly invest state resources on behalf of private commercial interests, in the coming years DEP should devote more of its resources to putting in place strong incentives to reduce waste and less resources to direct support for equipment. Programs such as PAYT on the residential side and Resource Management (RM) Contracting on the commercial side offer attractive and relatively low-cost ways for DEP to promote increased waste reduction.
- DEP’s *Commercial Waste Disposal Assessment* suggests appropriate priorities for targeting commercial waste reduction programs (e.g., food composting for the restaurant and food store sectors; paper recycling in medical/health institutions and in business service sectors; C&D in the construction sector). In most cases, DEP already has either pilot or ongoing programs in these sectors; but they will need additional focus, tools, and possibly resources. The pilot food collection program from restaurants and grocery stores is particularly promising and well targeted.
- Initial analysis of the pilot RM program is also very promising (potential to divert 20% or more of currently disposed tonnage). If the next phase of project and implementation of RM produces results of this magnitude, increased attention and resources from DEP would be warranted.
- PAYT pricing for solid waste services has proven to be an effective waste reduction tool for the residential sector (15–20+ % decrease in disposal tonnage), with more than 100 communities, representing roughly 20% of Massachusetts households, now operating under PAYT systems. DEP should expand its support for PAYT, targeting larger cities and suburban communities. Additional data tracking and analysis of PAYT impacts (including by size and characteristics of community and by waste type) are also warranted. The results could be used to modify diversion opportunity projections from the residential sector and to refine DEP’s PAYT assistance program.³
- Enhanced enforcement of DEP’s waste disposal bans is required to ensure higher levels of compliance and greater waste diversion. Although DEP increased its commitment to waste ban enforcement in 2001 with the hiring of four inspectors⁴, there was a violation rate of about 13% in FY 2002, meaning that significant tonnages of banned materials are

³ FY 2003 will be somewhat of a test of the need for DEP financial assistance for PAYT. Several communities appear to be ready to move forward with PAYT, but because of budget reductions, DEP will not be able to offer the financial assistance to communities it has in the past (\$10 per household to offset initial implementation costs, up to a maximum of \$125,000 per community). Whether or not communities go forward with PAYT, and the pace at which they do so, will be instructive for future budget allocations.

⁴ However, due to budget cuts, DEP recently laid off two of these inspectors.

still being disposed. Because of this and the Department's planned expansion of the waste bans to include certain construction and demolition (C&D) waste types, the Department should consider doubling its enforcement staff to eight full-time employees (FTEs). This increased staffing would support increased inspections at disposal facilities, as well as expanding waste ban outreach and enforcement to haulers and generators.

- Significantly more staff resources will be required to achieve the waste reduction goals in the Master Plan. Including the additional waste inspectors, we estimate that DEP staffing would need to increase from 20 FTEs in 2002 to 31 FTEs by 2010, with most of the new staff working to enhance commercial (and C&D) waste reduction.⁵
- DEP should take advantage of the flexibility offered in certain existing crosscutting programs, most notably MRIP and technical assistance (TA) grants, to strategically refocus on the priorities identified above. This can be accomplished largely through modifying eligibility and decision-making criteria for these programs.

⁵ We understand that the State's current financial situation has forced DEP to cut — rather than add — staff, including in the solid waste area. In order to successfully implement the programs described in this report and meet DEP's waste reduction goals, the Department will have to restore these cuts as soon as possible, and expand to the levels indicated within a few years.

II. Project Background

In December 2000, DEP issued the *Beyond 2000 Solid Waste Master Plan — A Policy Framework*, its plan and vision for managing solid waste over the coming decade. Although the *Beyond 2000 Master Plan* applauds the significant waste reduction accomplishments in the decade since the first Master Plan was issued in 1990 — including an MSW recycling rate of 38% and recycling services that were expanded to 85% of the population — it also recognizes the challenges to increasing waste reduction as “our growing economy has resulted in a waste generation rate that has outpaced our efforts to recycle solid waste.” In fact, over the past five years, the recycling rate in Massachusetts has stalled, increasing only 1–2 percent each year. The *Plan* states that “to go beyond the progress we have already made, we must embrace sustainability principles that require us to reverse recent trends of increasing waste generation by generating less waste, and to view discarded material that has served one purpose not as waste, but as a resource for another purpose.” It also calls on all stakeholders — government, citizens, institutions, the waste management industry, and the broader business community — to take on greater responsibility for waste reduction. The focus on sustainability and greater responsibility by various players represents an important evolution in DEP’s thinking and a recognition of the long-term economic and environmental benefits of integrated multi-stakeholder efforts to reduce waste and toxicity.

The *Beyond 2000 Master Plan* lays out the Department’s key long-term goals for solid waste management in the Commonwealth, including:

- reducing the waste produced by 70% through source reduction and recycling (60% MSW waste reduction and 88% C&D waste reduction); and
- removing toxics from the waste stream before recycling or disposal by providing universal access to hazardous product collection services (for residents and Very Small Quantity Generators (VSQGs)) by 2010.

In preparing the current *Waste Reduction Program Assessment and Analysis* report, we considered the various strategies identified in the Master Plan to achieve these goals, and some of these are highlighted in Section IV, below, on strategies.

The Department has already made significant progress toward implementing some of these strategies (e.g., launched the Product Stewardship Institute at UMass-Lowell, hired four waste ban inspectors, and issued revised facility site assignment regulations to provide increased protection of sensitive receptors). The Department plans to implement some of the other strategies shortly, such as a C&D disposal ban at the end of 2003, whereas others — including the requirement for Recycling Benefits Plans by disposal facilities — are being reconsidered.

While the *Master Plan* demonstrates a clear vision for the Commonwealth’s solid waste management through 2010 and identifies numerous strategies that DEP plans to pursue, it does not attempt to prioritize among the various programs, estimate their respective waste reduction impacts, or assess their relative cost effectiveness. Thus, in May 2002, DEP contracted with Tellus Institute and McKenzie-Mohr Associates to identify the most effective way to invest DEP’s grant, education, and technical assistance funds and deploy its staff resources to achieve the solid waste reduction and toxicity reduction goals stated in the *Master Plan*. The Tellus

project team has relied heavily on DEP staff to provide most of the relevant data, and has interviewed DEP staff to inform the program assessment and recommendations.

This project focuses on what DEP needs to do between now and 2010 to reach the waste reduction goals articulated in the *Master Plan*. The project includes an assessment of the best strategies to reduce waste at its source and increase participation in existing programs. It also identifies the most critical areas to expand recycling and composting access and infrastructure to move toward the 70% waste reduction goal. As such, this report is intended to provide a recommended “roadmap” for reaching this goal, identifying the sectors of the waste stream to target, the additional quantities of waste reduction that can be achieved in each sector, the strategies necessary to achieve these reductions, and the resource allocations required.

The project included the following key tasks:

- Review and assess current DEP waste reduction program information and data.
- Assess waste sector and sector component goals (e.g., recycling commercial office paper) through analysis of “technical potential” for diversion, the current diversion levels, and the realistic potential for additional diversion.
- Identify strategies and tools for realizing the potential additional diversion. This includes identifying gaps in current programs, and assessing how either expanded current programs or new programs (perhaps from other states) could address these gaps. An assessment of the role of community based social marketing (CBSM) techniques for increasing residential waste reduction was also conducted (by McKenzie-Mohr Associates).
- Assess the costs of various waste reduction strategies and, based on the relative cost assessment and the analysis of program potential, recommend priorities and resource allocations for the Department.
- Develop a methodology to improve DEP’s ability to track progress toward its goals, conduct comparative program assessments, and make needed adjustments to programs and resource allocation.

Note that this project is focused on expanding waste reduction efforts through 2010; we have not evaluated the implications of short-term budget reductions such as those being implemented for FY 2003. It is clear, however, that the Department will not be in a position to aggressively pursue new waste reduction initiatives this year. At best, we expect DEP to maintain existing programs and to invest very modestly and selectively in newer strategies. Although not addressed here, the recent budget cutbacks will likely slow the rate of progress that the Commonwealth will achieve, and therefore will slow the trajectory of reaching the 70% waste reduction goal through 2010. That is, with fewer resources and slower progress in the early years, the overall reductions required will have to be met over a shorter period (i.e., 5–6 years rather than 7–8 years), assuming that staffing and budget cutbacks last only a year or two. For strategies that require significant lead times and/or infrastructure development (e.g., commercial food waste composting), this could prove particularly challenging and could conceivably postpone the achievement of the waste reduction goals.

The results of this analysis are reported in the following sections of this report. In Section III, we assess the existing and realistic potential diversion by waste sector and waste type. In Section

IV, we identify the recommended strategies and tools for reaching this diversion potential and achieving the 70% waste reduction goal, prioritizing those sectors and programs with the highest realistic potential. Also, we briefly review the costs of existing DEP programs, estimate the costs of the recommended strategies, and discuss their relative cost effectiveness. Tellus estimated the 2002 costs based on DEP's FY 2002 Proposed Budget and other documentation, including reports on the FY 2002 Municipal Recycling Grant Program, the FY 2002 Technical Assistance Grants Summary Report By Grant Type, and DEP-provided staffing estimates. Expenditure levels for 2006 and 2010 are not intended to be precise funding recommendations. Rather, using the 2002 expenditures and program activity levels as a starting point, they are based on professional judgment and represent the priorities and shifts in funding levels we estimate are necessary to meet the waste reduction levels identified over this period. The projected expenditures do reflect the cost of programs that include direct payments based on activity levels (e.g., MRIP payments and per household grants for communities implementing PAYT).

Finally, in Section V, we summarize recommendations concerning the sequencing of budget and staffing investments/shifts during the period through 2010, as well as the additional data development and tracking that DEP needs to pursue in order to gauge progress toward the 70% goal and modify strategies as needed.

In addition to this report, a companion document prepared by McKenzie-Mohr Associates provides a review and recommendations on how to best utilize community-based social marketing to maximize residential waste reduction.⁶

⁶ *State of Massachusetts Residential Waste Reduction Programs: Review and Recommendations*, McKenzie-Mohr Associates, October 2002.

III. Assess Existing and Potential Diversion by Waste Sector and Waste Type

A. Approach

In order to ultimately recommend strategies and tools for waste diversion at the waste sector and sector component level (e.g., recycling commercial office paper), the first step in assessing DEP's current waste reduction programs is the development of waste composition figures for the residential, commercial, and non-MSW (i.e., construction and demolition or C&D) waste streams.⁷ Composition analyses will provide information on the types and quantities of various materials in each of the waste streams and will inform the development of source reduction and recycling programs that target the remaining recyclables in the waste stream. This information, combined with measures of the existing diversion, provides powerful information to guide program and policy development. Unfortunately, there are no reliable existing waste composition studies that characterize the Massachusetts waste stream by sector. Therefore, we have relied on composition studies from other jurisdictions and applied them to Massachusetts, making adjustments for local conditions where appropriate.

For residential waste, Tellus reviewed composition studies from numerous states, including California, Minnesota, and Oregon, and ultimately relied on 1999 composition reports from California and Minnesota for *disposed* residential waste. Unlike most national, state, or sub-state composition analyses, which do not distinguish between residential and commercial (and other waste), these studies provided percentages of disposed waste by waste type for the residential sector. We then applied these percentages to the overall quantity of residential waste disposed in Massachusetts to get the disposal composition in Massachusetts.⁸ To devise the total residential composition (disposed plus material diverted), we added the quantities of waste recycled and composted, as identified in the *Beyond 2000 Solid Waste Master Plan* and the *2000 Progress Report*, to the quantities disposed. Finally, we allocated the source reduced tonnage (including home composting) by waste type, to estimate the total potential generation.

Tellus used a similar approach for the commercial sector, relying on the DEP *Commercial Waste Disposal Assessment* (November 2002) to generate composition percentages for the commercial waste disposed in MA. These percentages were then applied to the overall quantity of commercial waste disposed in Massachusetts to get the commercial disposal composition tonnages. To devise the total commercial waste stream (disposed plus diverted material), we added the quantities of waste recycled and composted, as identified in the *Beyond 2000 Solid Waste Master Plan* and the *2000 Progress Report*, to the quantities disposed.⁹

⁷ The DEP *Master Plan* includes C&D waste in the "non-MSW" sector. Because C&D waste accounts for more than 95% of non-MSW waste, we call this sector C&D waste throughout this report.

⁸ For most materials, Tellus used an average of the CA and MN disposal composition. However, because CA is a bottle bill state and MN is not, and because of the significant differences in yard waste generation between California and Massachusetts resulting from climatic differences, for bottle bill materials and yard waste we selected the data from the more appropriate state.

⁹ Consistent with the *Beyond 2000 Solid Waste Master Plan* and the *2000 Progress Report* on the *Master Plan*, no commercial source reduction is assumed in 2000.

For the composition of the construction and demolition debris waste stream, we relied on DEP's *Beyond 2000 Master Plan* and the *2000 Progress Report*, supplemented by EPA's 1998 *Characterization of Building-Related Construction and Demolition Debris in the United States*. Note that reliable C&D composition data are not readily available for Massachusetts, and that the definition of C&D varies considerably from state to state. Although the *Master Plan* provides an estimate of total C&D generation, as well as recycling tonnages by material, it does not have data on overall composition of C&D waste (or what fraction of each material is recycled). Moreover, most C&D composition data from other states and the U.S. EPA focus exclusively on building-related C&D, whereas the Massachusetts C&D waste stream tonnages are for both buildings and highways/bridges combined. To derive an overall C&D composition for Massachusetts, we assumed that the vast majority (more than 95%) of road and bridge related C&D waste is currently being reused on-site as fill or recycled, and relied on EPA-generated data for building-related C&D.

By relying on detailed data from other jurisdictions and using the control totals provided in the *2000 Progress Report* (Table 3, page 9), we believe that the MSW and C&D composition figures for the various waste streams that we developed for this report are a reasonable representation of the Massachusetts waste stream in 2000.

Once existing composition was determined, we then calculated existing diversion rates based on recycling tonnage data provided by DEP. The Department's recycling tonnage is based on reports by municipalities through the annual Municipal Recycling Data Sheets (MRDS), the annual Recycling and C&D Processor Surveys, and the annual Compost Site Reports. For 2000 source reduction, we relied on the estimates DEP provided in the *Master Plan* and *2000 Progress Report*.

In consultation with DEP staff, Tellus made several simplifying assumptions to project waste generation rates and composition in 2010. First, we assumed that the composition of the waste stream, both in terms of the relative contribution among the sectors, as well as the contributions by waste type within each sector, remains constant through 2010. While we know that certain trends have been identified over the past few years that make it unlikely that the composition will remain static (e.g., lightweighting and a shift away from glass in food containers), these trends are occurring simultaneously, and their impacts generally occur slowly over many years. Second, we assumed that overall waste generation across all sectors tracks overall state economic activity and increases at the same rate as the gross state product over this period (28.4%). Although we recognize variability will certainly occur, particularly with respect to commercial subsectors (i.e., manufacturing versus retail), devising differential growth rates by sector is beyond the scope of this project and not necessary for the level of analysis presented in this report.

To estimate potential source reduction rates in 2010, we relied on the methods that Tellus developed for EPA's *Source Reduction Program Potential Manual* and the *Source Reduction in Massachusetts* report, as well as on professional judgment based on our understanding of the likely focus and effectiveness of source reduction activities in each sector (e.g., paper, corrugated and yard waste in the commercial sector).

To determine realistic diversion potential, we reviewed existing Massachusetts diversion rates as well as some of the most successful state and local programs around the country to identify diversion rates associated with “best practices.” Informed by existing diversion rates, and technical feasibility, the realistic potential diversion figures take into account logistical feasibility, the status of the required infrastructure and markets, the waste ban regulations, and the level of maturation of various programs.¹⁰

B. Existing Generation and Composition by Waste Stream

Tellus has prepared a series of summary figures and tables to highlight the results of our analysis of generation and composition by waste stream — residential, commercial, and C&D. Although Tables 1 through 8 are described in this section, they are presented at the end of the report, so as not to interrupt the report text.

B. 1. Residential Waste

Tables 1 through 3 present the residential waste picture with a waste composition derived from recent disposal composition studies in other states (California and Minnesota). Using the aggregated figures from the *Master Plan* as “control totals,” Table 1 calculates total residential waste generation, source reduction, and recycling/composting diversion by material. This 2000 data is used as a basis for our 2010 projections.

Table 2 presents a projected “base case” for residential waste in 2010 by simply growing the waste stream, source reduction, and recycling/composting by the expected change in the State Gross Product (28.4% over the ten-year period). These figures assume that the source reduction and recycling/composting diversion rates achieved in 2000 remain the same in 2010 and are applied to the larger waste stream. Although this does not represent Tellus’s realistic assumption, it provides a picture of “business as usual” and identifies the theoretical gap in waste reduction if the status quo is maintained through 2010.

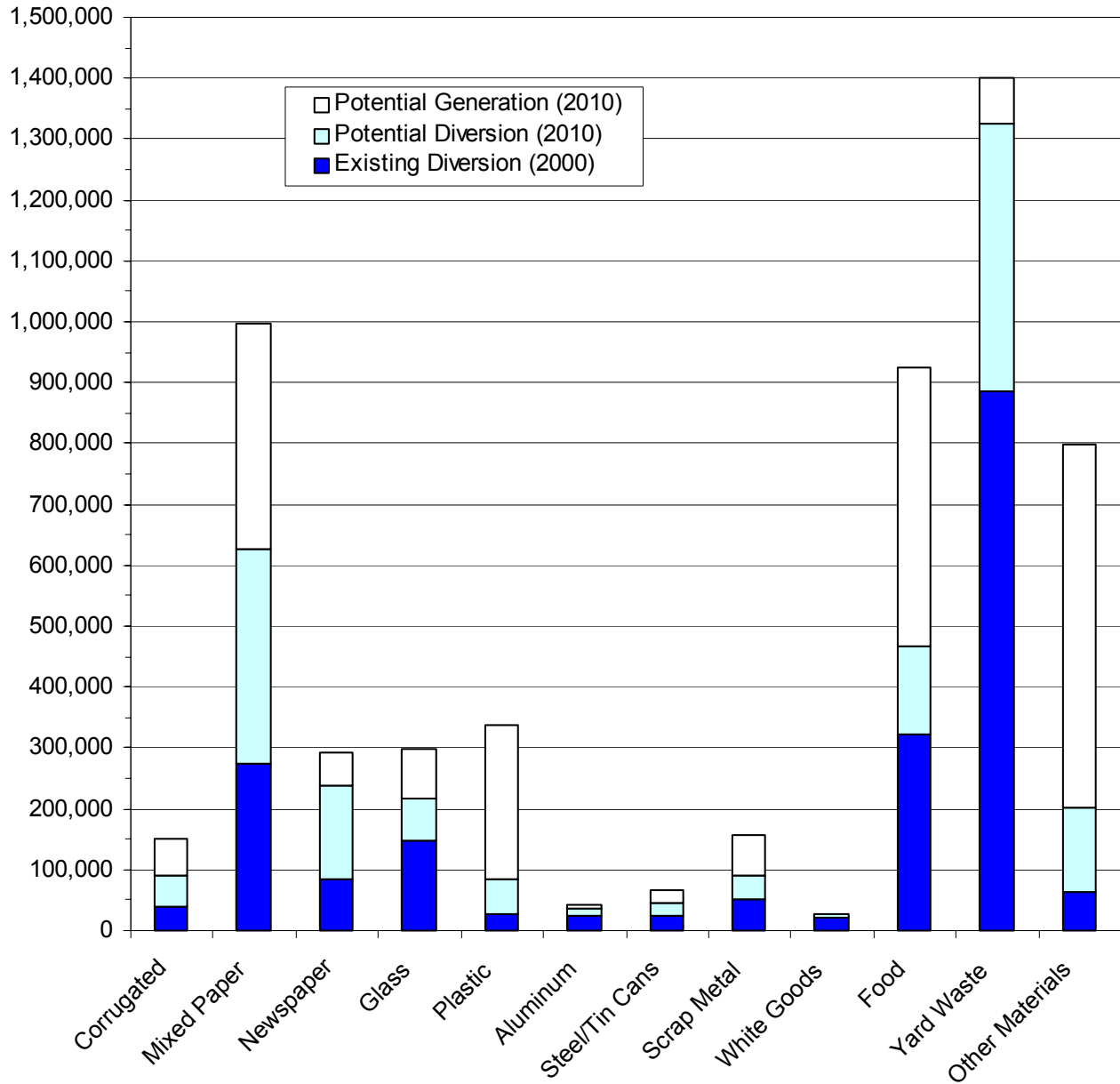
Table 3 presents our analysis of the technical and realistic potential for greater residential recycling and composting in 2010. It shows the recycling/composting diversion rate increasing from about 26% to almost 49% of actual generation in 2010, and the total realistic potential diversion rate (including source reduction) increasing from about 46% in 2000 to almost 63% in 2010. The realistic potential estimates are derived from Tellus’s review of experience in other jurisdictions and our professional judgment as to what is feasible in the Massachusetts context.

The additional potential diversion estimates calculated through Tables 1-3 are summarized in Figure 1, which highlights the current diversion levels, potential additional diversion, and projected generation by material category for the residential waste stream.

¹⁰ Note that after devising realistic potential diversion estimates for each waste type in the residential and commercial compositions, we checked these against internal DEP projected maximum recycling estimates that were used by DEP staff in developing the *Beyond 2000 Master Plan*. Although variations exist between these two data sets, the differences are relatively minor, providing additional support for our estimates of realistic potential diversion.

Figure 1

**Existing (2000) and Potential (2010) Diversion, Potential Generation (2010)
Residential Sector (Based on Tables 1-3)**



B. 2. Commercial Waste

Tables 4 through 6 present the commercial waste picture in 2000 and 2010. For these tables, the composition was derived from DEP's *Commercial Waste Disposal Assessment*, normalized using the aggregate figures from the *Beyond 2000 Solid Waste Master Plan* as "control totals." Table 4 utilizes the recycling tonnages from the 2000 Commercial Processor Surveys to derive recycling rates for paper, corrugated, glass, plastic and textiles. For other materials, the recycling and composting rates are based on Tellus's review of experience in other jurisdictions and nationally (as reported in U.S. EPA's *Municipal Solid Waste in the United States: 2000 Facts and Figures*), plus our professional judgment on current activity in Massachusetts.

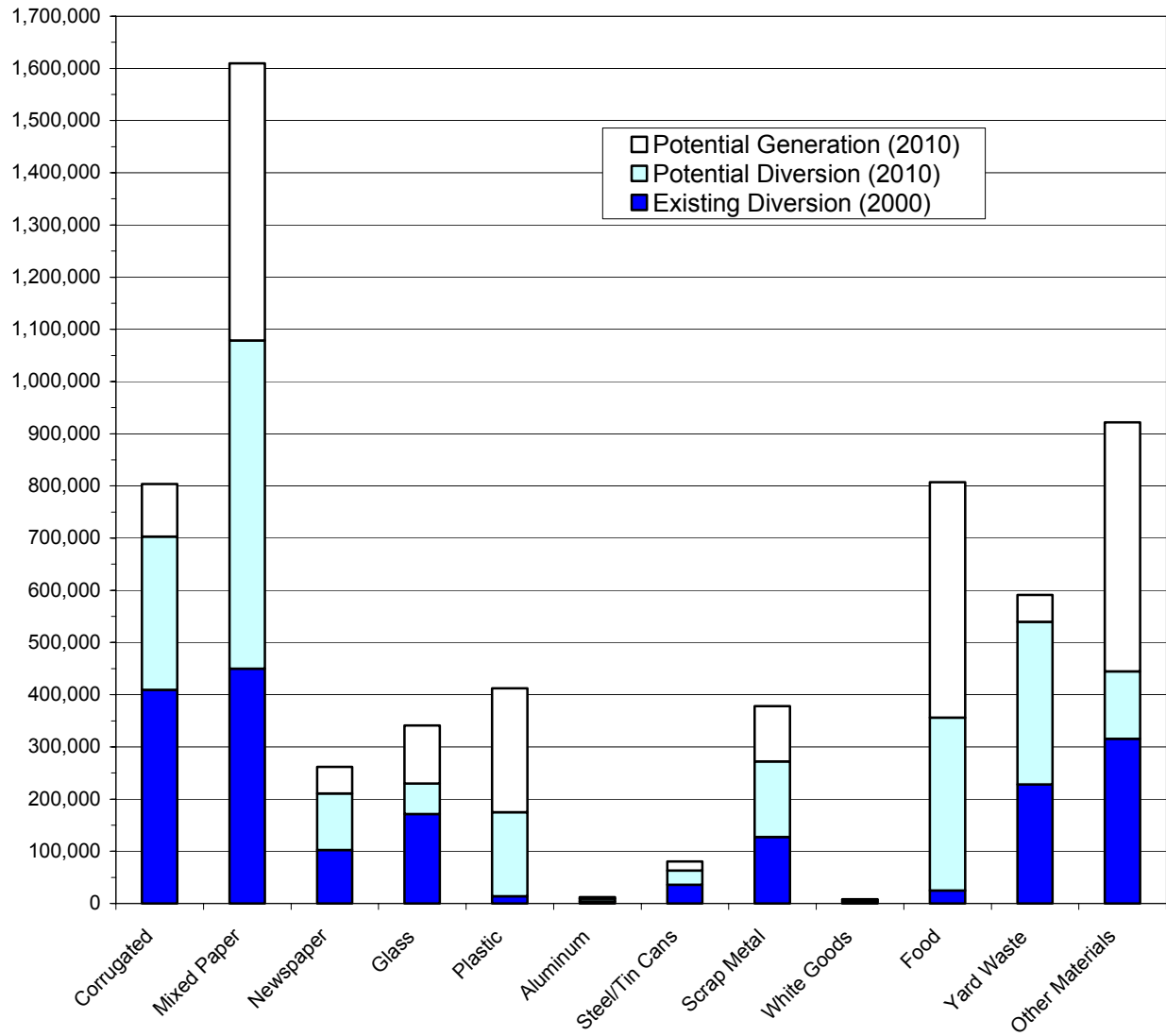
Similar to Table 2 for the residential sector, Table 5 presents a projected "base case" for commercial waste in 2010 by simply growing the waste stream, and recycling/composting, by the expected change in the State Gross Product (28.4% over the ten-year period). These figures assume that the recycling/composting diversion rates achieved in 2000 remain the same in 2010 and are applied to the larger waste stream. Recall that source reduction was essentially zero in 2000 and remains so in the base case. Again, although we do not consider this a realistic assumption, it provides a picture of "business as usual" and identifies the theoretical gap in waste reduction if the status quo is maintained through 2010.

Table 6 presents our analysis of the technical and realistic potential for greater commercial source reduction, recycling and composting in 2010. It shows commercial source reduction growing to about 16% of the potential total generation and the recycling/composting diversion rate increasing from 39% in the "base case" to 58% of actual generation in 2010 for an overall diversion rate of 64%. The realistic potential estimates are derived from Tellus's review of experience in other jurisdictions and our professional judgment as to what is feasible in the Massachusetts context. As described in Section IV, to approach this level of commercial waste reduction will require a significant focus of financial and staff resources by DEP over the coming years.

The additional potential diversion estimates calculated through Tables 4-6 are summarized in Figure 2, which highlights the current diversion levels, potential additional diversion, and projected generation by material category for the commercial waste stream.

Figure 2

**Existing (2000) and Potential (2010) Diversion, Potential Generation (2010)
Commercial Sector (Based on Tables 4-6)**



B. 3. Construction and Demolition (C&D) Debris

The composition and the existing and potential diversion of the C&D waste stream are difficult to estimate. The *2000 Progress Report on the Master Plan* provides a rough breakdown by material of the estimated 3.5 million tons of recycled C&D in Massachusetts, 94% of which is asphalt, brick and concrete. However, the composition of the almost 1 million tons of remaining C&D (disposed and net exported) is not addressed and is challenging to characterize. According to DEP's definition of C&D, there are two main categories of C&D waste: roads and bridges, and building-related. For each category, there are three types of activities that generate C&D waste: new construction, repair/renovation, and demolition. Nationally, EPA estimates that 43% of building-related C&D relates to residential buildings, whereas 57% is generated by commercial/ industrial buildings.¹¹ The composition of building-related C&D waste varies significantly from residential to commercial/industrial buildings. Moreover, the relative contributions from new construction, renovation, and demolition to the C&D waste stream are quite different for residential versus nonresidential buildings. This is summarized in the following table.

Summary of Estimated Building-Related C&D Debris Generation, 1996 (Roadway, Bridge, and Land Clearing Debris not included)			
Source	Residential (%)	Non-Residential (%)	Totals (%)
Construction	11	6	8
Renovation	55	36	44
Demolition	34	58	48
Totals	100	100	100
Percent	43	57	100

From: *Characterization of Building-Related Construction and Demolition Debris in the U.S.*, prepared by Franklin Associates for U.S. EPA, June 1998 (p. 2-11).

Unfortunately, there are not reliable comprehensive data on C&D composition that cover all of these categories for Massachusetts, the U.S. or other jurisdictions. However, there are a variety of data sources on specific types of C&D, particularly residential buildings, such as the EPA study cited above. Although this is useful in providing examples of C&D composition breakdowns for a limited number of building-related categories, much of the data is based on a small sample of C&D waste sorts in the Northwest. Given that building materials vary greatly from region to region (and even state to state) owing to proximity to wood and other building

¹¹ *Characterization of Building-Related Construction and Demolition Debris in the U.S.*, prepared by Franklin Associates for U.S. EPA, June 1998.

materials, as well as state building codes, there is considerable variation in the composition of C&D waste streams.

Nonetheless, a few general observations about C&D waste warrant attention here. The vast majority of road and bridge C&D waste is asphalt, brick, and concrete (ABC). Because there is a large volume of this material and it is heavy, most contractors use ABC on-site to avoid expensive transport and disposal. Thus, we assume that a large fraction of this waste is recycled or reused and only a very small fraction of road and bridge related ABC is disposed or exported. For building-related waste, data for new construction and renovation are generally more readily available (and accurate) than for demolition, largely because materials are more easily separated at construction and renovation projects. Demolition, particularly of commercial buildings, often results in a large undifferentiated “other” category that is landfilled. For the residential C&D waste stream, wood is the largest single component — comprising more than 40% — whether from construction, renovation, or demolition. Dry wall accounts for about 20% of the waste stream from residential new construction and renovation. Given their relatively short useful life, roofing materials make up a significant fraction (perhaps 25%) of residential renovation C&D waste; the percentage is less for new construction and demolition. For residential demolition, concrete and asphalt become more significant, because foundations and driveways are included. There is less composition data on the non-residential building C&D waste stream, partly because building types and materials vary even more than residential buildings, and general characterizations are more difficult to make.

Although it is likely that the vast majority of ABC is already being recycled or reused, because so much ABC is generated, there are still significant quantities of ABC that could be recycled, and there remain quantities of recyclable C&D material being disposed, particularly wood and gypsum wallboard. For new construction, corrugated cardboard also shows up in measurable quantities, though it is more important in terms of space than tonnage.

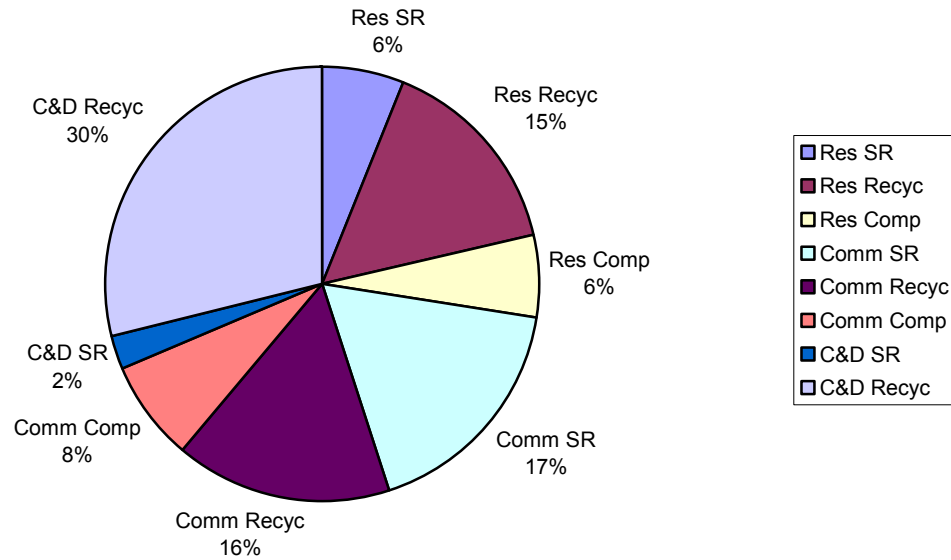
Table 7 presents the 2000 C&D waste composition and diversion picture. It shows that with a large fraction (estimated at 90%) of ABC being recycled, about 78% of total C&D generation is currently being recycled. When source reduction estimates are included, total diversion for C&D waste in 2000 is about 80%.

In Table 8, we project the 2010 C&D waste stream by growing the 2000 figure according to estimated increases in the GSP. Source reduction is assumed to remain at the same percentage as in 2000, meaning that it also grows with GSP. The realistic potential diversion figures assume that DEP proceeds with implementing its planned waste ban on unprocessed C&D wastes for at least some key materials (ABC, metal, wood) and increases the diversion rate from 80 to 88%. Including estimated source reduction, the overall diversion rate for C&D in 2010 is projected to be 89%. C&D recycling is estimated to increase from approximately 3.5 million tons in 2000 to more than 5 million tons in 2010. Note that without the ban, simply applying the 2000 C&D recycling rate to the 2010 tonnage (increased by the GSP) would have resulted in almost one million additional tons recycled, or about two thirds of the realistic additional potential. While we estimate in our realistic additional potential that ABC recycling increases by only a small percentage (from 90% to 95%), because of its dominance in the overall C&D waste stream it accounts for more than 1.1 million tons of the 1.5 million tons additional diversion.

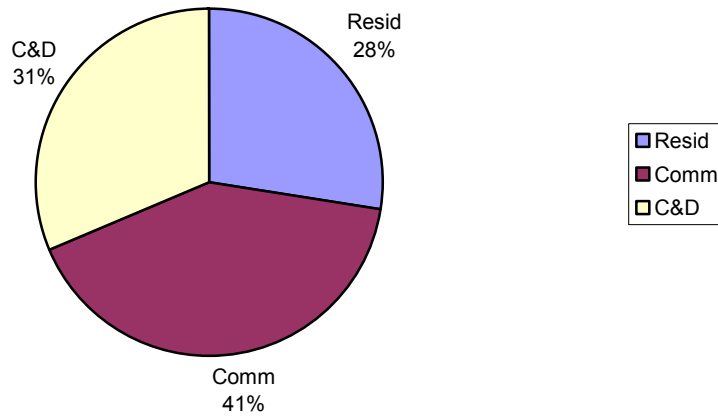
The majority of C&D metal waste is recoverable, and we assume the 2010 recycling rate for metal increases to 80%. Although targeted by the C&D waste ban, we estimate that a lower recycling rate for wood waste (70%) is achieved by 2010 due to its condition in the waste stream (e.g., difficult to separate, often painted or treated, and residential waste self-hauled by residents to transfer stations would not be covered under the forthcoming ban). Most other high-volume materials are assumed to be recycled at 50%, either because of their eventual inclusion in the waste ban (wallboard and possibly asphalt roofing), or because of their relatively high value and a targeted outreach effort (corrugated). A recycling rate of 30% is assumed for the “other” C&D waste category, reflecting the mixed nature of this stream and the difficulty in recycling it.

The following charts provide a summary of the potential additional diversion (from figures 1 and 2) by sector and diversion category. They clearly demonstrate that potential diversion is spread across sectors and diversion categories and that, therefore, DEP needs a comprehensive set of programs if it is going to succeed in reaching the 2010 waste reduction goals.

Potential Additional Diversion by Diversion Category
(Of Total Potential Additional Diversion of 5.4 million tons)



Potential Additional Diversion by Sector
(Of Total Potential Additional Diversion of 5.4 million tons)

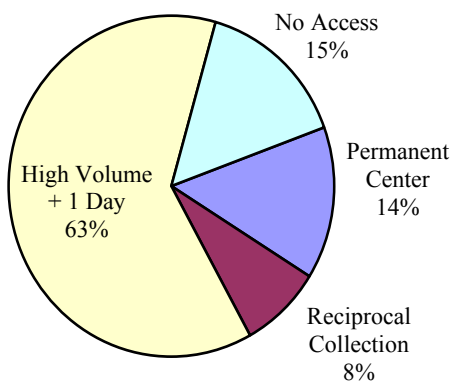


B.4. Household Hazardous Products HHP

The focus on HHP in the waste stream relates to toxicity rather than tonnage. The concern is for the potential environmental harm that these materials can cause, and the related human and ecological impacts. These wastes, therefore, require special management, with the aim of keeping them out of the solid waste stream. The goal articulated in the *Beyond 2000 Master Plan* is to “substantially reduce the use and toxicity of hazardous products and provide convenient hazardous product collection services to all residents and very small generators.”

For the purposes of this analysis and based on discussions with DEP, we consider residents (and VSQGs) to have convenient access to HHP collection services if the communities in which they reside:

- Have a local, permanent, comprehensive HHP collection center or participate in a regional one;
- Participate in at least three reciprocal HHP collection events per year (must be within a 30-minute drive);
- Hold at least three local HHP collection events annually; *or*
- Collect three of four high-volume hazardous products (oil, paint, mercury-containing items, CRTs) on a regular basis *and* hold one comprehensive collection event per year.



Massachusetts Population with Convenient Access to HHP Collection Services

Based on a review of DEP data on permanent HHP collection facilities, one-day collection events, and grants of HHP-related equipment (oil tanks, paint storage equipment, universal waste sheds), in 2001 there were 253 communities, representing almost 5.3 million Massachusetts residents, that had access to HHP collection under the above criteria. This represents more than 72% of municipalities and almost 85% of the population. Although more than 900,000 residents are served by the twelve comprehensive permanent HHP collection centers in Massachusetts,¹² and reciprocal collections serve another almost 500,000 residents, the majority of residents have access because their communities regularly collect at least three of the four high-volume hazardous products identified above and hold a one-day HHP collection event annually.

¹² These figures include centers in Newton and Worcester that have been approved and have received DEP financial support, but are not yet listed on the DEP Web site.

IV. Strategies and Tools by Waste Sector

A. Introduction

The previous section outlined the realistic diversion potential for the residential, commercial, and C&D waste streams. In the context of a growing waste stream nationally, and difficult economic conditions at least in the short run, achieving this additional diversion will be a significant challenge. Yet, as described in this section, with aggressive DEP action and adequate resources, the *Beyond 2000 Master Plan* goal of 70% waste reduction is achievable. Moreover, in the long run, meeting the waste reduction targets laid out in the *Master Plan* will prove economically and environmentally beneficial to the Commonwealth, its residents, and its businesses.¹³

In this section, we first summarize DEP's existing waste reduction programs and expenditures by waste stream. We then identify a set of strategies and tools for each waste-stream sector that, in combination, the Commonwealth will need to implement to meet its waste reduction goals. These are broken down into source reduction, recycling, and composting strategies for each sector. For example, one of the **strategies** to increase Residential Recycling is to "Expand Support for Pay-As-You-Throw Programs." The **tools** required to expand PAYT include outreach and education, technical assistance, MRIP criteria, and others.

It is important to note that waste reduction generally results from a combination of programmatic initiatives — public education, infrastructure development, technical assistance, economic incentives, regulation and enforcement, market development, etc. — rather than from a single tool. Because each of these mutually reinforcing initiatives contributes to the success of waste reduction strategies, it is not possible to calculate the specific tonnage diversion or cost effectiveness of individual tools. Thus, Tellus used the following approach to develop recommended strategies and cost estimates:

- Identify the remaining realistic potential for waste reduction by waste sector and material (see Section III above);
- Focus strategies on sectors with the greatest remaining potential for waste reduction;
- Prioritize strategies and tools based on the effectiveness of existing implementation efforts in Massachusetts and elsewhere, the ease and relative cost of implementation (based on past experience), the level of perceived and/or real barriers, and a desire to balance legislative/regulatory tools with incentives and market-based initiatives; and
- Estimate costs and DEP staffing requirements to implement the suite of strategies and tools recommended for each sector.

Note that there are several strategies and tools, such as specific public education activities and implementation of MRIP, that cut across waste sector categories, where the costs and benefits are shared among several programs. While we will identify the waste-stream sectors and strategies

¹³ A 1999 study estimated the net benefits of recycling at \$120–\$230 per ton when social, economic, and environmental benefits are considered, including direct job creation; health, land, water, and ecosystem benefits from reduced pollution; and less need for future remediation. See: *Recycling 2000: Recommendations for Increasing Recycling in the Commonwealth of Massachusetts*, Lisa A. Skumatz, Ph.D. and Jeffrey Morris, Ph.D., February 1999.

that these crosscutting tools support, the costs associated with these tools are discussed separately at the end of this section. Also, our recommended strategies emphasize and provide more detail for those tools that hold the most promise for increasing waste reduction and require additional funding or staff resources. Other tools that DEP utilizes to support each sector strategy are listed and characterized throughout this section of the report, with an indication as to which warrant continued financial and staff investment at more or less than FY 2002 levels, and which may warrant relatively less emphasis and resources than in the past, particularly if budgets are tight. These existing sets of tools are briefly listed but not described in detail.

While the combination of the strategies and tools recommended in this report have been selected based on a detailed review of the Massachusetts waste management context, we suggest that DEP continuously assess the progress and effectiveness of these strategies, and modify them as programs evolve, the waste stream changes, and more is learned about what works best in different sectors. Moreover, it is clear that certain strategies will have varying impacts on, and therefore may be more or less appropriate for, different types of communities or businesses. For example, backyard composting programs generally impact suburban communities more than urban ones, as they tend to have larger lawns than their urban counterparts and more space for the composting bins. Similarly, programs targeted at increasing multifamily recycling will apply primarily to those urban communities with significant multifamily housing stock.

The strategies and resource allocation shown throughout this section of the report reflect the fact that different sectors require a different set of strategies and that there are four stages of implementation:¹⁴

- **Exploratory:** Research and pilot projects to determine what strategies will work best.
- **Infrastructure Development:** Build necessary collection, processing, and market infrastructure.
- **Increase Participation:** Increase participation of waste generators in established programs.
- **Maintenance:** Maintain infrastructure and participation rates and evaluate and adjust strategies.

Figure 3 below illustrates the primary stages for each of the major waste stream areas that this analysis focuses on as of 2002. The strategies explained in the text are largely dependent on their position (i.e., stage) in this continuum. In Figure 4, these stages are depicted as projected for 2010. Figure 5 provides an overview of DEP's waste reduction strategies, with the location of the boxes indicating which sectors they affect, and strategies that cut across multiple sectors shown at the bottom.¹⁵ Crosscutting strategies for each sector (i.e., Residential, Commercial, C&D) are described in more detail at the end of each of the relevant sections.

¹⁴ These stages and the diagram that follows were identified and developed by DEP staff in the course of this project.

¹⁵ This flowchart was developed by DEP staff; Tellus has made minor modifications in the version that appears here.

Exploratory	<i>Infrastructure Development</i>	<i>Increase Participation</i>	<i>Maintenance</i>
Source Reduction (all wastes)			
C&D Recycling			
Commercial Recycling			
Commercial Composting			
		Residential Composting	
		Residential Recycling	
HHP			

Figure 3: Current Implementation Stages by Waste Stream Sector

Exploratory	Infrastructure Development	Increase Participation	Maintenance
Source Reduction (all wastes)		Source Reduction (all wastes)	
		C&D Recycling	
		Commercial Recycling	
		Commercial Composting	
		Residential Composting	
		Residential Recycling	
		HHP	

**Figure 4: Targeted Implementation Stages by Waste Stream
Sector: 2002-2010**

B. Existing Residential Programs and Expenditures

DEP currently supports many different programs that target residential source reduction, recycling, and composting. There are also crosscutting programs that encourage reduction of residential waste as well as furthering goals in other waste generation sectors. The following list represents a reasonably complete picture of current Department efforts.

<u>Residential Source Reduction:</u>	Home Compost Bin Grants Junk Mail Reduction Kits
<u>Residential Recycling:</u>	Core Equipment Grants Core Educational Grants Recycling Education Campaign Recycling Contracting/Planning Grants Recycling Coordinator Grants Recycling Education in Public Schools Program Community-Based Social Marketing Projects Bottle Bill
<u>Residential Composting:</u>	<i>Although there are several crosscutting programs that impact residential composting, there are no DEP programs that are exclusively targeted toward the off-site diversion of residential organics.</i>
<u>All Residential Waste Reduction:</u>	PAYT Grants DARP Criteria
<u>Crosscutting:</u>	Technical Assistance MRIP Criteria/Grants Regional Collection Centers–Recycling, Composting, HHP Recycling Market Development Programs Product Stewardship Waste Ban Enforcement

Historically, more than 65% of DEP's annual Clean Environment Fund (CEF) budget has been allocated to municipal/ residential programs. In fiscal year 2002, the combination of programs predominantly oriented toward residential waste reduction comprised about \$8 million, or two-thirds of the total \$12 million CEF budget.¹⁶ Less than 5% of the residential portion was directed to programs focused exclusively on either source reduction or composting, whereas nearly 30% was allocated to recycling-focused programs and almost 70% was spent on crosscutting programs that span the entire residential sector.

In terms of DEP grant funding, between 1995 and 2001, 75% to 80% of Technical Assistance (TA) Grants were awarded in support of residential waste reduction goals.¹⁷ About 90% of this

¹⁶ These percentages consider MRIP as a crosscutting program historically focused predominantly on the residential sector. This focus has begun to shift over the past two years, and we anticipate and encourage a further shift toward commercial (and C&D) waste reduction activities in the coming years. Assuming that this shift continues, MRIP is best considered as an MSW crosscutting program impacting both the residential and commercial sectors.

¹⁷ Based on DEP's "Technical Assistance Grants Summary Report 1995-2001."

amount was targeted toward residential recycling, a minor portion of the remainder went to composting-specific grants, and the remainder supported residential source reduction efforts. FY 2002 saw a modest but meaningful shift in overall allocation of DEP TA grants away from residential recycling.¹⁸ The allocation for residential efforts dropped to less than 60% of the value of total grants awarded, of which 75% went to residential recycling and less than 15% went to each of residential source reduction and composting. Of Municipal Recycling Grants (TA plus equipment grants, plus PAYT support), DEP data indicate that approximately 70% was allocated to residential programs in FY 2002. About 5% of this went to source reduction efforts, nearly 9% was awarded for composting-related purposes, and the balance was targeted to increase residential recycling.¹⁹

Finally, DEP has been providing about \$950,000 per year in Redemption Center Grants to support these businesses. These centers primarily serve the residential sector and account for an estimated 40% of redeemed containers. The reimbursement rate paid to redemption centers to handle redeemable containers has not increased for a number of years, and many claim that they could not stay in business without DEP grant support.

C. Recommended Strategies for Residential Waste Reduction²⁰

A summary of the potential diversion and recommended expenditures for residential waste reduction is provided in Table 9, below, followed by a discussion of the remaining diversion potential by waste type, and the specific recommended strategies for residential sector waste reduction.

¹⁸ For the purposes of this analysis, TA grants that were made to municipalities to encourage commercial diversion such as Business Recycling Assistance grants are considered to be commercial grants.

¹⁹ Note that overall TA grant funding increased dramatically in FY 2002, increasing from less than \$150,000 in FY 2001 to more than \$1.75 million in 2002, because of the release of additional CEF funds by the Legislature.

²⁰ As mentioned earlier, residential programs are typically delivered through municipalities and are managed by DEP's Municipal Waste Reduction Branch.

Table 9: Summary of Potential Diversion and Recommended Expenditures for Residential Waste Reduction Strategies

	Total Waste Reduction	Source Reduction	Recycling	Composting
Total 2010 Potential (tons)	3,447,000	1,490,000	1,289,000	668,000
Current Diversion (tons)	1,968,000	1,160,000	473,000	335,000
Additional Potential Diversion (tons)	1,479,000	330,000	816,000	333,000
Estimated 2002 Funding	\$3,652,000 ²¹	\$131,000	\$1,761,000	\$148,000
Recommended 2006 Funding	\$3,890,000 ²²	\$200,000	\$1,500,000	\$200,000
Recommended 2010 Funding	\$4,070,000 ²³	\$250,000	\$1,250,000	\$250,000
Implementation Stages Targeted Between Now and 2010	-- Increase Participation -- Maintenance	-- Exploratory -- Increase Participation -- Maintenance	-- Increase Participation -- Maintenance	-- Increase Participation -- Maintenance

A projection of the Commonwealth's waste generation to the year 2010 indicates a potential generation of 5.5 million tons of residential waste, with approximately 3.0 million tons remaining undiverted (see Table 2). The composition of that remaining waste suggests materials to target through 2010.²⁴

Largest Types of Disposed Residential Waste in Massachusetts		
Mixed Paper	20%	640,000 tons
Food Waste	17%	510,000 tons
Plastic	10%	300,000 tons
Yard Waste	9%	260,000 tons

Note that large quantities of undiverted materials do not necessarily translate into tonnages that can be easily diverted; this depends on the various factors comprising the "realistic diversion potential" for each material. Table 3 summarizes the estimated realistic diversion potential across materials. The waste reduction strategies that follow are targeted to those waste types with the highest tonnage of realistic diversion potential. Yard waste presents the greatest opportunity for significant diversion, offering the potential for 94% total diversion (1,324,861 tons) in 2010 through source reduction and increased composting. Mixed paper also offers

²¹ Includes cost of crosscutting residential programs, but not overall crosscutting programs.

²² Includes cost of crosscutting residential programs, but not overall crosscutting programs.

²³ Includes cost of crosscutting residential programs, but not overall crosscutting programs.

²⁴ A group of "Other Materials" actually represents about 736,000 tons or 21% of the undiverted waste. This category includes residues, composites, and other "problem" materials that are difficult to target for recycling.

significant potential through source reduction and recycling increases; we estimate that approximately 63% total diversion (626,537 tons) could be achieved by 2010.

It should be noted that the finding that significant tonnages of yard waste are being disposed is somewhat contrary to the conclusions of DEP's 1999 *Residential Organic Waste Management Study* (prepared by Tellus), which found that residents self-reported effective yard waste diversion 95% of the time. However, there are indications (e.g., waste ban inspections, effect of PAYT on off-site yard waste diversion in Lexington) that a significant amount of undiverted yard waste may remain in the waste stream. Targeting yard waste is also in line with the recommendations of EPA's *Cutting the Waste Stream in Half: Community Record-Setters Show How* (EPA-530-R-99-013), which concludes that "collecting and composting yard trimmings is a key to reaching 50% and higher waste reduction levels and doing so cost-effectively."

As described in Section IV.A, above, the DEP is in the exploratory stage of fostering source reduction programs, regardless of the sector or target material. It will be important for the Department to continue testing innovative ideas to determine how it can influence source reduction most effectively. However, significant current source reduction has been estimated in spite of the relatively low level of DEP involvement, and it is projected to continue through 2010. A modest increase in DEP emphasis and funding on strategies to promote residential source reduction, with particular focus on promotion of home composting, should yield significant additional waste reduction beyond that level, including reduction of target material disposal. In addition to the recommended strategies discussed below, because mixed paper is such a large contributor to the residential waste that is disposed, DEP should expand its efforts to publicize the availability and benefits of junk mail reduction kits while continuing to distribute them through its grant programs. If possible, a more systematic follow-up with kit recipients should be implemented to provide better information on this program's effectiveness.²⁵

Broad strategies to encourage both source reduction and recycling/composting will help reduce disposed tonnage of an array of materials, including these target materials. The recommended strategies discussed here often reinforce each other in promoting waste reduction. For example, a PAYT system and more stringent enforcement of waste bans should encourage additional home composting.

Recommended strategies are detailed below, but these should not be construed as comprising an exclusive list of areas for DEP resource allocation. While additional funding and staff resources are necessary to implement these recommended strategies, continued support for many ongoing activities — particularly crosscutting efforts that support multiple programs — is also necessary. These are briefly listed along with their associated costs later in Section IV.

²⁵ Although junk mail reduction kits are a relatively new DEP initiative, there has been notable interest from communities in Massachusetts that have sought to distribute them to their residents. Though preliminary data show only about 5% (1,347 of 25,000) of those receiving junk mail kits have returned their completed post cards to DEP indicating which actions they have taken, the initial results are promising: 98 percent have returned cards to have their names removed from mailing lists, more than 50% of those providing feedback have called the toll-free numbers of credit card or direct marketing companies to have their names removed from mailing lists, almost 50% have called to cancel catalogs that they do not want to receive, and 85% report that they recycle the junk mail they do receive. Although respondents are self-selected and may not be representative of all recipients of the junk mail kits, these figures are encouraging.

It is important that the Commonwealth maintain current levels of residential waste diversion and source reduction if the 2010 60% waste reduction goal for that generating sector is to be achieved, as this analysis shows is possible. Continued investment in current DEP programs at appropriate levels will be necessary to do this. In general, investment in tools that support the strategies recommended here should be increased, including:

- Home Composting Bin Grants
- Junk Mail Reduction Kits
- PAYT Grant Assistance
- Waste Ban Enforcement

These investments are integral to the recommended strategies, although a careful assessment of municipal reaction in FY03 to the lack of PAYT grants will be informative for subsequent years' funding of that strategy. If municipalities continue to adopt PAYT in spite of lessened or alternate forms of DEP assistance (such as staff time), the state should consider continuing to rely more on that type and level of assistance, rather than on additional grants.

The recommended strategies also depend upon continued funding support for other core tools including:

- Core Educational Grants
- Recycling Education Campaign
- Recycling Planning Grants
- Recycling Coordinator Grants
- Recycling Education in Public Schools Program
- Community-Based Social Marketing Projects

In addition to these programs, there are several that should remain priorities for funding in recognition of the contribution they make to existing and continued diversion. Continued funding of Technical Assistance Grants provides a flexible way for DEP to further its understanding of effective strategies and provide customized support to municipalities, and MRIP is a flexible and apparently effective tool that should continue to be used to influence municipal provision of programs and access.

The Recycling Equipment Grants program should be refocused and narrowed, with funding for equipment that focuses on expansion of recycling access to new populations, either multifamily residences or communities with new recycling programs. Grants for additional or replacement equipment in communities maintaining their existing recycling programs should no longer be provided.

Also, DEP should consider the relative importance of redemption center grants, given their high cost (almost \$1 million per year) and low tonnage impact, although these funds have been a legislative earmark in the past. The level of support for redemption centers is likely to be a highly visible and political issue. On the one hand, DEP's total CEF funding is derived from deposits that are not redeemed, and only a fraction of such funds are returned to the distributors and retailers. Moreover, there is evidence that the bottle bill and the availability and convenience of redemption centers (DEP estimates that redemption centers handle roughly 40%

of redeemed bottles and cans) are an important contributor to litter reduction and recycling. If funding for redemption centers were reduced or discontinued, and if this caused a significant number to close, a noticeable increase in litter and a decrease in recycling may result. On the other hand, the relatively high cost per ton spent on supporting redemption centers may not be justified given other potentially more effective uses for these funds. One option worth considering is an increase in the handling fee paid to redemption centers. Though this would require a change in EOEPA regulation, it could directly and efficiently provide the centers with the required resources, and reduce the need for DEP involvement.

With about 600,000 tons of food waste and more than 515,000 tons of yard waste disposed in the projected 2010 waste stream, there is definite potential to reduce the overall tonnage of organic waste disposed through strategies that foster increased off-site composting. Unfortunately, residential food waste cannot be easily managed off-site. Although home composting is emphasized as a source reduction strategy above, the vast majority of the additional residential composting tonnage will be leaves and yard waste, and most of the costs to achieve this diversion will be spent on the PAYT and waste ban enforcement programs. Nonetheless, we recommend additional expenditures on targeted education and outreach, focused technical assistance to municipalities, and a modest increase in staffing (up to .5 FTE).

Strategy #1: Expand Support for PAYT Programs

Diversion Categories Targeted: Source Reduction, Recycling, and Composting

Material Categories Targeted: All

Relevant Implementation Stages: Increase Participation, Maintenance

Implemented in more than 100 communities representing approximately 20% of Massachusetts households (1.24 million people), PAYT programs are an effective mechanism to provide direct incentives to residents to reduce waste generation and disposal. Given the recent pace of PAYT program implementation and expressions of interest by municipalities across the Commonwealth, with modest increases in DEP support it is reasonable to assume that, by 2010, PAYT could be implemented in municipalities comprising 50% of Massachusetts households. This implies that, over the next seven years, new communities representing roughly 1.86 million people will need to implement PAYT. Given that, to date, PAYT has been implemented more extensively in smaller communities in the central and western part of the state, to achieve PAYT systems serving 50% of the statewide population will require several larger cities (such as Springfield, Fall River, Framingham, and others) and suburban communities adopting it. For example, more than 60 additional communities with an average population of 30,000 would need to implement PAYT to reach this level.

Estimates of PAYT's impact vary, but suggest that PAYT can achieve a 15 percent reduction in disposal tonnage. Roughly one-third of this is generally achieved through source reduction (including increased home composting, see strategy #2 below), whereas two-thirds is attributable to recycling and composting.²⁶

²⁶ The 15% waste reduction impact of PAYT is derived from: Lisa A. Skumatz, 1996, *Nationwide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies*; Marie Lynn Miranda and Sharon LaPalme, 1997, *Unit Pricing of Residential Solid Waste: A Preliminary Analysis of 212 U.S. Communities*, *Duke University Nicholas School of Environment*; and recent Tellus PAYT analyses for Massachusetts DEP.

Several tools are necessary to support the development and to evaluate the effectiveness of PAYT programs. General outreach and education are necessary to build a base level of awareness and acceptance of PAYT (see McKenzie-Mohr Associates report, Section 4.1). MRIP criteria, technical assistance grants, and education/outreach materials grants encourage municipalities to explore the PAYT option, provide expertise that can help them structure an effective program, and minimize up-front burden. Research and evaluation activities help DEP make sure that PAYT programs are as effective as possible.

This effort will require focused financial and staff resources by DEP over this period. In particular, we estimate that DEP staffing for PAYT would need to at least double to 1.5 FTE. Also, if the current first-year payment of \$10 per household for communities that implement PAYT is continued (up to a maximum of \$125,000 per community), achieving the 50% target would cost an estimated \$750,000 per year, compared with FY02 PAYT grant expenditures of \$250,000.²⁷

Strategy #2: Encourage Home Composting

Diversion Categories Targeted: Source Reduction

Material Categories Targeted: Leaves and yard waste, food waste

Relevant Implementation Stages: Increase Participation, Maintenance

More than 1.1 million tons of organics remain undiverted in the projection of the 2010 residential waste stream. At the same time, EPA's *Organic Materials Management Strategies* (EPA530-R-99-016) and additional unpublished research conducted by Tellus for EPA in 2001 have found that home composting is one of the most cost effective and environmentally sound management methods for most yard *and* food waste.

It is clear that, because of the DEP yard waste disposal ban and longstanding composting programs in most communities, the vast majority of yard waste is being diverted from disposal. Yet, significant tonnage remains undiverted. DEP has also estimated that the majority of food waste is disposed with trash or garbage disposal. EPA's *Source Reduction Program Potential Manual* (EPA530-R-97-002) indicates that 75% of the population are in residences that have space to home compost. EPA's *Organic Materials Management Strategy* report determined that 90% of all yard trimmings could be home composted, as could 72% of food scraps.

DEP's *Organics Study* concluded that Commonwealth residents have been receptive to state-generated home composting education and bin grant programs but that there has been relatively low awareness of its potential, particularly in relation to food waste composting. Since the initiation of the Home Composting Bin Distribution program in 1994, 230 municipalities have participated, distributing about 100,000 bins. These findings support our recommendation that DEP redouble its efforts to subsidize bins and provide education and outreach assistance. It may be particularly effective to encourage food waste composting among residents who are already home composting yard waste. This is an area where it may be useful to utilize community-based social marketing techniques to develop more effective and targeted messages. Additional increases in home composting would be leveraged by implementing PAYT in conjunction with home composting outreach.

²⁷ Note that we assumed that roughly 200,000 of the 800,000 additional households would be in large communities whose payments would be capped at \$125,000 (e.g., Springfield, Framingham, and others).

Strategy #3: Increase Access and Participation Among Multifamily and Subscription-Served Households

Diversion Categories Targeted: Recycling

Material Categories Targeted: All

Relevant Implementation Stages: Infrastructure Development, Increase Participation, Maintenance

DEP estimates that up to 12% of Commonwealth residents do not receive recycling service that is as convenient as their trash collection. Most of these people live in multifamily residences, but others live in areas where collection services are provided by private subscription haulers. Together, these residents represent a sector that needs better access to recycling opportunities. Moreover, participation by multifamily and subscription-served households in recycling and other waste reduction programs is particularly low. The Department should continue to encourage municipalities to provide this access through its MRIP grant criteria and equipment grants (primarily for large-volume recycling carts) that facilitate multifamily recycling. Education and outreach to apartment building owners and their tenants, as well as to underserved subscription households, can also foster increased demand for and participation in such programs. This may be another area where targeted CBSM efforts could play a role.

Strategy #4: Enhance Waste Ban Enforcement

Diversion Categories Targeted: Source Reduction, Recycling, and Composting

Material Categories Targeted: All

Relevant Implementation Stages: Increase Participation, Maintenance

The existing waste bans on a wide variety of recyclable materials — and the relationship of the bans to a community's Department Approved Recycling Program (DARP) status — can be a very effective means of encouraging municipalities to ensure that banned materials are largely removed from the waste stream. Last year DEP hired four full-time waste ban inspectors who completed about 350 inspections across nearly 300 transfer stations, landfills, and incinerators. Although larger facilities are appropriately inspected more frequently, only about half of the eligible facilities were inspected last year. In general, greater presence from inspectors would likely identify more violations, and would lead to greater diligence on the part of facility personnel. This is particularly true with the facilities that are still sloppy or inconsistent with procedures. It is these facilities that, over time, the inspectors should be targeting for more frequent inspections and enforcement actions.²⁸

Some waste ban inspectors have been successful in getting facilities to identify large generators of failed loads. This enables DEP to follow up directly with the generator (with an official letter from DEP). Based on initial results, the Department believes this strategy may be very effective in increasing compliance. However, to obtain more leads from facilities would require more time from DEP inspectors to ask for them, and/or to do more inspections. Although facilities do

²⁸ It should be noted that most facility inspections (comprehensive and ongoing monitoring) do not involve a site visit by a DEP inspector. Rather, DEP relies heavily on the records that facilities keep. One of the trends they look for is whether failed loads are noted when DEP staff are not there.

not want to be seen as “informants” on their customers, increased inspection and enforcement are an effective method for convincing facilities to enforce the bans and educate their customers.²⁹

One other potential inspection/enforcement strategy identified by DEP is to require poor-performing facilities to change their compliance plan in order to ensure that restricted material is not accepted for disposal. This would be contingent on the availability of adequate staff resources as it would require DEP staff assistance to facilities to develop strategies on how they would keep restricted material out, review such strategies, possibly modify facility permits, and oversee the entire effort.

The key tool for enhanced waste ban enforcement is more DEP staff. The recommended staffing level and the costs associated with this are discussed below in Section IV.H with overall crosscutting tools.

Crosscutting Residential Tools

A number of flexible tools can be used to support and enhance multiple strategies and diversion categories. These include communication and educational programs and mailings, and certain facility and technical assistance grants. As summarized in the following table, except for a reduction in facility equipment-related grants (from about \$380,000 in 2002 to \$100,000 by 2010), the funding and staffing level for these programs should be maintained or increased modestly. Without continuation of these core programs, residential recycling programs would likely suffer, resulting in lower recycling rates. Backsliding of residential recycling programs could be a serious impediment to meeting the 2010 waste reduction goals. For example, if the residential recycling rate projected for 2010 dropped 5%, recycled tonnage would decrease by more than 300,000 tons.

Cost Estimates for Key Crosscutting Residential Programs		
<u>Program</u>	<u>2002</u>	<u>2010</u>
Muni./Educ. Mailings	\$ 620,000	\$ 700,000
Equipment Grants	\$ 380,000	\$ 100,000
Facility-Related Grants	\$ 350,000	\$ 350,000
TA Grants	\$ 380,000	\$ 380,000
Operations/Staff	\$ 535,000	\$ 605,000
Subtotal	\$2,265,000	\$2,135,000

Other crosscutting tools that can be used to influence the commercial and C&D waste streams, in addition to the residential sector, are discussed later in Section IV.H. These include MRIP; market development programs; and educational programs such as the statewide education

²⁹ Because of its potential benefit, DEP should consider the feasibility of extending the waste bans to haulers and generators.

campaign, public schools and events, and other communication tools. In 2002, these educational activities were overwhelmingly aimed at the residential sector. However, because the focus of educational activities can shift over time (as we suggest they do for 2010), for purposes of this report these expenditures are treated as crosscutting all sectors.

Historically, DEP has put the greatest emphasis on strategies designed to encourage residential recycling. Although the tools used are among the most mature of the Department's programs, there is significant tonnage remaining undiverted. The recommended budget level assumes a decline in recycling equipment grants, except for new curbside or multifamily programs, and a modest decline in technical assistance grants reflecting the maturity of this program area.

Not included here is the approximately \$1.33 million that was spent on overall public education in 2002, including \$1,155,000 on the statewide education campaign, \$150,000 on public schools and events, and \$25,000 on other communication tools. In 2002, these expenditures were for educational activities overwhelmingly aimed at the residential sector. However, because the focus of educational activities can shift over time (as we suggest they do by 2010 to include the commercial and C&D waste sectors), for purposes of this report, these expenditures are treated as crosscutting all MSW sectors in Section F, below.

D. Existing Commercial Programs and Expenditures

DEP's support for commercial waste reduction programs is relatively new and not nearly as well established as on the residential side. To date, most of the efforts to address the commercial sector have been crosscutting, such as waste ban inspections and recycling market development assistance. The recent addition of a category of MRIP criteria to "encourage waste reduction in small to medium-sized businesses" is an important example of DEP's evolving recognition of the important waste reduction opportunities in the commercial sector and the role that municipalities can play.

The following list represents a reasonably complete picture of current DEP programs that support commercial waste reduction:

<u>Commercial Source Reduction:</u>	Materials Exchange
<u>Commercial Recycling:</u>	Recycling Cooperative Grants Recycling Services Directory
<u>Commercial Composting:</u>	Food Waste Density Mapping Study Supermarket and Restaurant Food Waste Pilots
<u>All Commercial Waste Reduction:</u>	Commercial Waste Disposal Assessment Resource Management Contracting WasteCap (Waste Audits, Assistance, Outreach)
<u>Crosscutting:</u>	Technical Assistance MRIP Criteria/Grants Recycling Market Development Programs (including the Recycling Loan Fund and the Recycling Industry Reimbursement Credit Grants) Product Stewardship Waste Ban Enforcement

Until very recently, DEP has focused relatively little attention and few resources on the commercial sector. This is consistent with the historical focus of waste reduction efforts across the U.S., but is also due to the fact that DEP does not have as direct control over the management of commercial waste as it does over the municipal/residential stream. With residential waste reduction programs becoming more mature, it is only in recent years that DEP has started to devote significant financial and staff resources to reducing the commercial waste stream. This is confirmed by an analysis of DEP's Technical Assistance Grants since 1995, which are indicative of overall program emphasis. In the period 1995 to 2001, about 78% of TA funds were awarded for residential programs, and only about 3% were awarded to address commercial waste reduction (exclusively recycling), with the remaining 19% devoted to HHP programs.

There was a significant shift in FY 2002 DEP TA grants in favor of activities targeting the commercial sector, which received about 24% of the TA funds (18% was for recycling projects, with 2% for source reduction and 4% for composting).³⁰ At the same time, TA funds for residential projects were reduced to 58% of the total (with 43% for recycling, and the remainder split between source reduction and composting). In terms of Municipal Recycling Grants (TA plus equipment grants, plus PAYT support), DEP data indicate that only about 14% of the funds was allocated to commercial programs in FY 2002.

Although the overall allocation of resources has changed somewhat in fiscal year 2002, the programs predominantly oriented toward commercial waste reduction still comprised only about \$2 million, or roughly 17%, of the total \$12 million CEF budget. Approximately 12% of the commercial portion was directed to programs focused exclusively on either source reduction or composting, whereas about 27% was allocated to recycling-focused programs, and 60% was spent on crosscutting programs that span the entire commercial sector.³¹

E. Recommended Strategies for Commercial Waste Reduction

In the *Master Plan*, DEP identifies the commercial sector as offering the greatest waste reduction opportunities over the next decade, and key to meeting the 2010 waste reduction goals. Our analysis confirms this view.

A summary of the recommended strategies for commercial waste reduction is provided in Table 10 below, followed by a discussion of the remaining diversion potential by waste type and the specific recommended strategies for commercial sector waste reduction.

³⁰ Note that overall TA grant funding grew dramatically in FY 2002, increasing from less than \$150,000 in FY 2001 to more than \$1.75 million in 2002, because of the release of additional CEF funds by the Legislature.

³¹ These percentages consider MRIP as a crosscutting program historically focused predominantly on the residential sector. This focus has certainly begun to shift over the past one to two years, and we anticipate and encourage a further shift toward commercial (and C&D) waste reduction activities in the coming years.

Table 10: Summary of Potential Diversion and Recommended Expenditures for Commercial Waste Reduction

	Total Waste Reduction	Source Reduction	Recycling	Composting
Total 2010 Potential (tons)	4,099,000	932,000	2,510,000	657,000
Current Diversion (tons)	1,891,000	0 ³²	1,638,000	253,000
Additional Potential Diversion (tons)	2,208,000	932,000	872,000	404,000
Estimated 2002 Funding	\$815,000 ³³	\$90,000	\$575,000	\$162,000
Recommended 2006 Funding	\$1,718,000 ³⁴	\$130,000	\$775,000	\$300,000
Recommended 2010 Funding	\$2,035,000 ³⁵	\$150,000	\$850,000	\$350,000
Implementation Stages Targeted Between Now and 2010	--Infrastructure Development -- Increase Participation -- Maintenance	-- Exploratory -- Increase Participation -- Maintenance	-- Infrastructure Development -- Increase Participation -- Maintenance	-- Infrastructure Development -- Increase Participation -- Maintenance

According to DEP's *Commercial Waste Disposal Assessment* (November 2002), five key materials account for more than 70% of all waste disposed by Massachusetts businesses in 2000. The materials and their estimated percentage contributions were:

Top Five Types of Disposed Commercial Waste in Massachusetts	
Paper	28%
Food	18%
Yard Waste	11%
C&D	10%
Cardboard	7%

Note that, although the *Disposal Assessment* includes C&D as one of the commercial waste streams, in the current report C&D is addressed separately as the main non-MSW waste stream.

The *Disposal Assessment* report points out that some of these materials (such as corrugated cardboard and paper) were disposed by many industrial sectors, while other materials (such as food waste) were concentrated in just a few sectors. Based on material disposal amounts per industry sector, the report identifies the "Top Ten Potential Target Areas for 2000." This is

³² Zero source reduction means generation has increased at the same rate as economic indicators (GSP).

³³ Includes cost of crosscutting commercial programs, but not overall crosscutting programs.

³⁴ Includes cost of crosscutting commercial programs, but not overall crosscutting programs.

³⁵ Includes cost of crosscutting commercial programs, but not overall crosscutting programs.

particularly relevant and helpful in the current Waste Reduction Evaluation Project because it highlights the specific material types and industries to consider for commercial waste reduction programs.

Top Ten Potential Target Areas for Waste Reduction			
Material Type	Industry Group Name	Amount	% of Total
Food	Retail Trade - Restaurants	347,400	8.4 %
Paper	Service - Medical/Health	220,000	5.3 %
C&D	Construction	169,200	4.1 %
Paper	Services - Business Services	162,600	3.9 %
Paper	Retail Trade - Restaurants	118,500	2.9 %
Food	Retail Trade - Food Store	110,700	2.7 %
Paper	Retail Trade - Other	85,300	2.1 %
Textiles	Services - Business Services	78,900	1.9 %
Other Organics	Service - Medical/Health	72,300	1.8 %
Paper	Services - Other Professional	72,000	1.7 %

The paper and food waste streams account for seven of the top ten targets and clearly warrant additional attention. It is important to note that the estimates from the *Commercial Waste Disposal Assessment*, cited above, are based on waste multipliers developed by the California Integrated Waste Management Board applied to Massachusetts employment data. There are important differences between these states in terms of the character of certain industries and their associated waste management practices. Moreover, the *Disposal Assessment* report does not consider the level of existing waste reduction activity for any materials or industries.³⁶ It is possible that a “Potential Waste Reduction Target Area” identifies a material type and industry that is either already achieving a high level of waste reduction, and for which it may be difficult to achieve additional diversion, or one where there are significant barriers to increasing diversion. Thus, while these figures are helpful for broad program planning purposes, we also consider existing waste reduction levels, availability of collection and processing capacity, number and density of businesses in a sector, amount of material per location, markets for diverted material, and a variety of other factors in identifying and prioritizing commercial waste reduction strategies and tools for DEP.

Mixed paper (320,000 tons), corrugated (200,000 tons), and organics (240,000 tons of yard waste and food) account for the vast majority of the more than 930,000 tons of source reduction potential in the commercial sector (see Table 6). We anticipate that some of this reduction will

³⁶ Similar to the Massachusetts and California reports, most published waste characterization studies focus on waste disposed rather than waste generation, because they are usually based on waste sorts of truckloads of material entering disposal facilities. Therefore, they do not account for recycling and waste reduction activities prior to disposal.

be achieved — regardless of DEP activity — because of continued changes in how businesses and institutions operate, such as increasing reliance on electronic communications, lightweighting of products, reduced packaging, and increased focus on reuse (e.g., pallets) to avoid disposal costs. Along with the primary strategies discussed here, DEP should consider extending its junk mail campaign to the commercial sector.³⁷ These same materials, plus metals, account for the vast majority of the potential commercial recycling tonnage.

As described above in Section III, the *Disposal Assessment* was a key input in developing the commercial composition and realistic diversion potential figures in Tables 4–6. Based on this analysis, we recommend the following commercial waste reduction strategies and tools in order to achieve DEP’s waste reduction goals.

Strategy #1: Resource Management (RM) Contracting

Diversion Categories Targeted: Source Reduction, Recycling, and Composting

Material Categories Targeted: All

Relevant Implementation Stages: Exploratory, Infrastructure Development, Increase Participation

RM contracting addresses an essential and often overlooked component of integrated waste management: contractual relationships between waste generators and service providers. Contracts are pervasive in the commercial solid waste field and directly influence the way that the vast majority of Massachusetts businesses manage their waste. To date, DEP has done much to test and prove RM contracting through the development of information and the use of RM pilots. RM contracting is a relatively new non-regulatory, market-based method to reduce commercial waste generation and increase recovery of useful materials. RM contracts align the interests of both generators and haulers so that they share the financial benefits of reduced waste generation and disposal.

As in other jurisdictions, these Massachusetts pilots have shown great promise for diverting significant fractions (an additional 15–30+%) of the commercial waste stream. We anticipate that most of the benefit from RM contracting, particularly in the early phases, will be in higher commercial recycling rates, as waste haulers (or “RM contractors”) focus primarily on enhancing what they already know how to do (collect and market recyclables). However, as businesses and RM contractors gain experience, to go beyond this “low hanging fruit” the RM compensation mechanism can act as an incentive for contractors to move further upstream to focus on source reduction opportunities. Over time, the strategic alliances formed may enable RM contractors to influence upstream decisions related to product design and material choice, use, and handling, not just disposal practices. This upstream focus will be necessary for RM contracting to achieve significant waste reductions and contribute to the Commonwealth reaching its ambitious waste reduction goals by 2010.

³⁷ Certain direct mail companies focus on businesses and, as for the residential sector, there are steps that can be implemented to reduce junk mail at businesses. Examples of organizations that can be contacted include Red Flag (www.redflagservices.com), which helps reduce junk mail addressed to former employees by “cleaning” their lists of terminated employees; Dun & Bradstreet (www.zapdata.com), which creates and sells business marketing lists; and Info USA (www.infousa.com), another major creator and seller of business lists. One simple approach is for employers to provide postcards for employees to send to direct marketers that send unwanted mail.

It should be noted that RM contracting has thus far been most successful with larger businesses where substantial dollars (on an absolute basis) are spent on waste management. RM's effectiveness for waste reduction in small- and medium-sized businesses may be far less.³⁸

DEP's RM pilot project attempted to include a range of commercial entities including universities, a hospital, a grocery store, an office building, and others. As DEP proceeds to implement the next phase of RM, it makes sense to be strategic with respect to which sectors are focused on. Specifically, given the "top ten" potential waste reduction target areas described above, RM implementation efforts should include a focus on medical and health facilities (including hospitals), business services (financial and other), and possibly certain retail stores (including food stores and restaurants), with a particular focus on increasing the diversion of paper and corrugated. The Department should continue to closely monitor the results of the RM pilot projects; future support of RM should be contingent upon continued success of the pilots.

Building on this work, the next step is to create a sustainable, long-term market for RM services. To accomplish this will require additional resources from DEP over the next two years to educate and motivate both potential customers and suppliers of RM services. The goal should be to develop and implement a critical mass of RM programs so that customers and RM service providers will perpetuate RM contracting activity without significant further DEP resources. Over the next two years, DEP should also work to build capacity in an existing technical assistance provider to the commercial sector such as WasteCap, to conduct education, outreach and contracting support.

Strategy #2: Expand Technical Assistance to Businesses

Diversion Categories Targeted: Recycling

Material Categories Targeted: All, especially paper

Relevant Implementation Stages: Increase Participation

In addition to recognizing that tremendous opportunity for waste diversion remains in the commercial sector, DEP has recently focused on utilizing its traditional constituents — municipalities — to leverage waste reduction activity in the business sector. It has done so by modifying its MRIP criteria and the work of the MRIP coordinators to include emphasis on commercial recycling. This makes sense, given DEP's ongoing relationship to and involvement with municipal solid waste management activities, existing capacity at the municipal level, and the challenges that the Department faces to directly impact commercial management practices. In FY 2002, DEP went beyond its traditional support for market development activities and devoted staff and grant resources to commercial composting and recycling. Specifically, this included several grants to municipalities to work with businesses to increase waste diversion, holding business recycling workshops for municipal officials, and preparing commercial recycling guidance materials for municipal officials. DEP should expand efforts to promote commercial recycling through staff assistance and technical assistance grants, focusing both on municipalities and business organizations/trade associations as entities that can reach businesses

³⁸ One possibility for effectively employing RM with small companies is to form a consortium where, for example, a landlord or office park owner negotiates an RM contract on behalf of its tenants. Such an approach was implemented in a Boston office building in one of the DEP-sponsored RM pilots, and is currently being considered by Massachusetts Development/Devens Enterprise Commission for the business and institutional entities at Devens. Also, in another one of the pilot projects, a medium-sized hotel is currently seeking bids for an RM contract. The result of this will be instructive with respect to RM's viability for small- and medium-sized companies.

and encourage behavior changes in solid waste management in the commercial sector. DEP should work with municipalities to focus these efforts on those sectors with the greatest potential for diversion, including medical and health facilities (including hospitals), business services (financial and other), and retail stores (including food stores and restaurants).

Strategy #3: Expand Food Composting

Diversion Categories Targeted: Composting

Material Categories Targeted: Food waste; also cardboard, especially from supermarkets

Relevant Implementation Stages: Exploratory, Infrastructure Development, Increase Participation

Food is one of the two most important waste types that remain in the commercial disposal stream, with restaurants and supermarkets among the largest generators. DEP has just completed important work that will form the basis for an expanded commercial food waste composting program. The recent food waste mapping report prepared for DEP, *Identification, Characterization, and Mapping of Food Waste and Food Waste Generators in Massachusetts* (Draper/Lennon, Inc., September 2002), found three key commercial food waste-generating sectors — the food manufacturing industry, supermarkets, and restaurants. The report also found that many manufacturers are already diverting a large fraction of their food waste, whereas restaurant food waste diversion is challenging because of their small individual size and concerns about sanitation, collection logistics, and contamination. On the other hand, supermarket food waste was found to be a particularly attractive target for diversion because they have a reasonably homogeneous waste stream, the vast majority of waste from this sector comes from fewer than a dozen supermarket chains, and each supermarket generates substantial tonnage of food waste on a regular basis.

The Department has also recently funded a supermarket pilot project and a set of three pilot restaurant food collection projects in Boston, Newton/Needham, and Northampton. The results of these projects are preliminary, although the supermarket pilot is particularly promising in terms of its potential to divert a large quantity of organic waste in a cost-effective manner. As DEP moves forward with these initiatives, it is clear that local uses or markets for food waste remain an important issue needing DEP attention. Although it is evident that supermarket food waste diversion efforts should likely be targeting stores throughout the Commonwealth, if restaurant diversion programs are to move forward, they should be targeted to only those locations where the density of restaurants is high and their proximity to processors/end-users is close enough to warrant food collection programs.

We estimate that implementing these commercial waste composting activities will require a doubling of DEP staffing to about 1.5 FTE.

Strategy #4: Enhanced Waste Ban Enforcement

Diversion Categories Targeted: Source Reduction, Recycling, and Composting

Material Categories Targeted: All

Relevant Implementation Stages: Increase Participation, Maintenance

In addition to various market-based incentives and other programs, to ensure that businesses continuously expand their diversion efforts, DEP needs to expand its regulatory presence through

the enforcement efforts of its waste ban inspectors. As described above for the residential sector, this is one of the most effective means of increasing waste reduction. The approximately 300 inspections conducted per year should be expanded so that facilities, particularly commercial transfer stations, are visited more frequently. In terms of commercial source reduction, improved waste ban enforcement would encourage additional focus by businesses on improving procurement policies and practices, paper reduction, as well as reduction and reuse of packaging. It should also encourage businesses to look at innovative approaches to waste management such as Resource Management Contracting. Enhanced enforcement of the waste ban should be complemented by more focused educational efforts concerning the bans and proper diversion targeted to commercial generators, including the landscape contractors that service such businesses.

Crosscutting Commercial Tools

Estimates for the costs of crosscutting commercial programs are presented below. Current and projected expenditures on crosscutting commercial waste reduction programs relate primarily to RM contracting, technical assistance grants, and DEP staffing. The increase in the cost of staffing reflects the expected additional focus on the commercial sector.

Cost Estimates for Key Crosscutting Commercial Programs			
	<u>2002</u>	<u>2006</u>	<u>2010</u>
Resource Management Contracting	\$50,000	\$200,000	\$100,000
Education/Mailings (Buy Recycled)	\$80,000	\$200,000	\$300,000
Expanded TA Grants	\$355,000	\$550,000	\$700,000
Operations/Staff	\$260,000	\$518,000	\$585,000
Subtotal	\$745,000	\$1,468,000	\$1,685,000

F. Crosscutting MSW Programs

As discussed previously, programs such as general public education, market development activities, and certain waste reduction pilots cut across and benefit both residential and commercial sectors. These efforts are the foundation for, and critical to the success of, all the MSW waste reduction programs. We suggest a modest increase for general public education activities, as DEP encourages the next step in increasing diversion rates. DEP support for waste reduction research/pilots should also continue as a flexible mechanism for exploring new waste reduction technologies and programmatic opportunities. The focus of the research and pilots will likely change over time, with significant attention paid to the commercial and C&D sectors. The costs associated with these programs are summarized below.

Cost Estimates for Key Crosscutting MSW Programs		
	<u>2002</u>	<u>2010</u>
Public Education	\$1,330,000	\$1,500,000
Waste Reduction Research/Pilots	\$ 250,000	\$ 250,000
Subtotal	\$1,580,000	\$1,750,000

G. Recommended Strategies for C&D Waste Reduction

A summary of the recommended strategies for C&D waste reduction is provided in Table 11 below, followed by a discussion of the remaining diversion potential by waste type and the specific recommended strategies for C&D waste reduction.

Table 11: Summary of Potential Diversion and Recommended Expenditures for C&D Waste Reduction

	Total Waste Reduction	Source Reduction	Recycling
Total 2010 Potential (tons)	5,655,000	600,000	5,055,000
Current Diversion (tons)	3,970,000	470,000	3,500,000
Additional Potential Diversion (tons)	1,685,000	130,000	1,555,000
Estimated 2002 Funding	\$450,000 ³⁹	\$50,000	\$400,000
Recommended 2006 Funding	\$675,000 ⁴⁰	\$125,000	\$550,000
Recommended 2010 Funding	\$750,000 ⁴¹	\$150,000	\$600,000
Implementation Stages Targeted Between Now and 2010	-- Exploratory -- Infrastructure -- Increase Participation -- Maintenance	-- Exploratory -- Increase Participation -- Maintenance	-- Infrastructure Development -- Increase Participation -- Maintenance

As discussed in Section III, DEP includes two main categories in C&D — waste related to construction and repair of roads and bridges, and waste related to the construction, renovation and demolition of buildings. Because the former category accounts for the majority of C&D waste, and a very high fraction of it is reused or recycled, the overall diversion rate for C&D was about 80% in 2000. Nonetheless, there are still significant quantities of C&D waste (about one

³⁹ Includes cost of crosscutting C&D programs.

⁴⁰ Includes cost of crosscutting C&D programs.

⁴¹ Includes cost of crosscutting C&D programs.

million tons in 2000) that remain in the waste stream and are disposed. This remaining building-related waste is the focus of the recommended strategies described here.

Although there are currently no DEP programs focused exclusively on C&D source reduction, in 2002 DEP provided five Technical Assistance Grants for C&D waste totaling \$76,000 (including source reduction grants to the Boston Materials Reuse Center and ReStore in Springfield). Also, in 2002 the Department supported a C&D research project (with a budget of \$45,000) and awarded four Recycling Industries Reimbursement Credit (RIRC) grants totaling about \$277,000 for C&D recycling. Our 2010 C&D source reduction estimate simply maintains the current percentage of source reduction and applies it to the anticipated 2010 C&D waste stream. (As was assumed for MSW, the 2000 generation of C&D waste has been increased by the anticipated growth in GSP.) The 2010 recommended budget relates to the training and education program recommended below, along with a modest technical assistance effort.

In addition to the strategies described below, DEP should continue to encourage increased C&D recycling through MRIP criteria and research/pilot programs. The Department should also maintain its support for market development programs for C&D materials, including through the RIRC program.

Strategy #1: Implement Waste Ban on Unprocessed C&D Waste

Diversion Categories Targeted: Source Reduction, Recycling

Material Categories Targeted: Initially, wood, metal, asphalt, brick, and concrete; potentially, other C&D materials such as gypsum wallboard and asphalt shingles at later dates

Relevant Implementation Stages: Infrastructure Development, Increase Participation, Maintenance

DEP plans to implement a disposal ban for at least some unprocessed C&D waste materials (asphalt, brick, concrete, metal, and wood) by December 31, 2003. The ban, combined with enhanced enforcement, will be the single most important tool for diverting significant additional quantities of C&D. Based on their relative contribution to the overall C&D waste stream, it makes sense for DEP to target these materials, as they account for almost 70% of the C&D that remains in the waste disposal stream. The other materials that DEP should consider including in the ban are gypsum wallboard and roofing, assuming that appropriate processing facilities and end-use markets can be established. We anticipate that the ban will have a modest impact on C&D source reduction, but should lead to significant increases in C&D recycling from about 3.5 million tons in 2000 to more than 5 million tons in 2010.

Strategy #2: Enhanced Waste Ban Enforcement

Diversion Categories Targeted: Source Reduction, Recycling

Material Categories Targeted: New C&D ban materials identified above, plus existing banned materials such as corrugated and yard waste

Relevant Implementation Stages: Infrastructure Development, Increase Participation, Maintenance

To make a new C&D waste ban effective, and to ensure maximum compliance with existing material bans, increased enforcement is necessary. DEP should consider assigning specific waste inspectors to C&D processing facilities. Though it is difficult to provide precise estimates, enforcement of the waste bans will result in a fraction of the C&D waste that previously was disposed to now be reduced at its source, primarily through increased reuse on site.

Note that corrugated cardboard is already banned from disposal facilities, but the ban generally has not been enforced for the C&D waste stream. Though corrugated is a small fraction of the overall C&D waste stream (it is almost nonexistent in demolition waste), it comprises 5% or more of the waste stream for new construction and renovation. Moreover, it is a bulky and relatively high-value waste. Thus, DEP's enforcement of the existing ban on corrugated should be extended to C&D waste.

Strategy #3: Targeted C&D Waste Reduction Education

Diversion Categories Targeted: Source Reduction, Recycling

Material Categories Targeted: All

Relevant Implementation Stages: Exploratory, Infrastructure Development, Increase Participation

To be effective, the C&D waste ban should be accompanied by targeted education and training efforts. These should be aimed at C&D contractors as well as C&D processing and disposal facilities. The educational efforts should focus primarily on demolition and building renovation contractors as opposed to new-construction contractors, because the latter account for less than 10% of the C&D waste stream, although targeted education and technical assistance for large new residential construction projects, such as new subdivisions and multifamily housing, should be considered. Specific C&D educational opportunities include adapting and customizing brochures or workshops on demolition and salvage and job- site recycling; developing and disseminating model C&D reuse and recycling specifications for use by demolition firms, renovation contractors, and builders; and developing a guide on Massachusetts vendors and/or markets for recycled C&D. Strong models of such educational tools have been developed by King County, Washington; the Greater Vancouver Regional District; and the Triangle J Council of Governments in Research Triangle Park, North Carolina, among others.

H. Recommended Strategies for HHP Reduction

As discussed in Section II.B.4, above, the HHP goal articulated in the Master Plan is to “substantially reduce the use and toxicity of hazardous products and provide convenient hazardous product collection services to all residents and very small generators.” To date, DEP has focused primarily on the latter part of the goal: providing convenient access. While permanent full-service HHP collection centers are the most effective means for capturing HHP waste, such facilities have proven to be difficult to site and expensive. Thus, DEP should continue to financially support development of permanent local and regional facilities on an opportunistic basis, but the bulk of the Department's near-term efforts should be devoted to continuing its focus on providing equipment to help municipalities manage high-volume HHP waste as an appropriate alternative to permanent facilities. This should be targeted at the largest remaining 60–100 Massachusetts communities that currently do not have collection equipment or programs, with technical assistance to rural communities encouraging regional cooperation in collection.

In 2002, DEP devoted about \$660,000 or about 6% of its total CEF budget to HHP programs. About two-thirds of this expenditure (roughly \$450,000) was for HHP equipment and service grants such as CRT recycling grants, oil tanks, paint storage sheds, universal waste sheds, and grants to develop permanent HHP collection facilities. Also, \$50,000 supported the school

chemicals management and clean-out program, and more than \$155,000 was spent on the approximately 2.25 FTE devoted to HHP activities. In addition, implementation of mercury material separation plans by combustion facilities working with municipalities has further expanded collection services for mercury-containing products.

DEP's activities have succeeded in making HHP collection available to approximately 85% of Massachusetts' residents. With this high level of access achieved, and an understanding that HHP collection programs generally have very low participation rates, we recommend that DEP focus increased attention on expanding participation in existing HHP collection programs. What is less clear, however, is the HHP collection access achieved for small businesses that generate small quantities of HHP wastes (VSQGs), which are included in DEP's *Master Plan* goal of universal access. Unfortunately, very little data exist on VSQGs' use of municipal HHP collection programs. Although residential access may be a reasonable proxy for small-business access, the Department may want to gather data through survey or other methods on VSQGs' access to existing HHP collection programs and the best way to expand such access. DEP should consider using CBSM-based techniques in this effort.

In addition, the Department should increasingly support product stewardship initiatives so that some of the responsibility and cost for managing products containing hazardous materials is borne by the manufacturers and sellers of such products, rather than solely by state and municipal governments. This support will likely include legislative and policy initiatives (e.g., recent mercury reduction efforts), participation in direct negotiations with manufacturers, and expanded source separation planning (beyond mercury-containing products) at waste combustion facilities. Product stewardship efforts will also help provide appropriate price signals to the marketplace, as waste management costs are internalized in product prices.

We recommend roughly level funding and staffing for HHP reduction efforts through 2010, but these resources should be shifted over time from providing equipment and facilities for access to increasing participation and promoting product stewardship.

Strategy #1: Increasing Participation

Diversion Categories Targeted: Source Reduction, Recycling

Material Categories Targeted: All HHPs, particularly high-volume hazardous products (oil, paint, mercury-containing products, CRTs)

Relevant Implementation Stages: Increase Participation, Maintenance

With the necessary infrastructure largely in place, increasing participation in HHP collection programs will require DEP and municipalities to educate residents and small businesses about its importance in reducing environmental risks and costs. Similar to the successful messages developed to promote recycling, targeted educational programs should focus both on the need for HHP collection and on how easy/convenient it is to participate. The educational tools may include HHP education/outreach grants to municipalities, the annual HHP forum and other training programs on HHP, and inclusion of HHP issues as a component of statewide education efforts. Also, DEP should explore the use of CBSM methods to promote participation in HHP collection activities. Moreover, MRIP criteria could be used to encourage both resident and small business participation.

Strategy #2: Product Stewardship & Environmentally Preferred Procurement**Diversion Categories Targeted:** Source Reduction, Recycling**Material Categories Targeted:** High-volume hazardous products and products with persistent bioaccumulative toxics**Relevant Implementation Stages:** Exploratory, Infrastructure Development, Increase Participation

To shift some of the responsibility for managing products with hazardous materials and to encourage manufacturers to shift to non-hazardous alternatives, DEP (in conjunction with the Executive Office of Environmental Affairs) should continue and expand its support of the Product Stewardship Institute at UMass-Lowell, including participating in and/or supporting the National Electronics Product Stewardship Initiative (NEPSI). The Department should develop and/or support product stewardship legislation in Massachusetts and explore implementing pilot take-back programs. To promote market development, we recommend that DEP also support additional focus on the Massachusetts' well-regarded Environmentally Preferable Product Procurement Program on lower-toxicity products, including alternatives to products containing persistent bioaccumulative toxics (PBTs). In fact, the Department may want to consider supporting legislative bans on the sale of certain products containing PBTs where comparable substitutes are readily available or banning disposal of such products (similar to the CRT ban). To complement these efforts, DEP should expand the requirements of Material Separation Plans to go beyond mercury and include other PBTs.

I. Overall Crosscutting Programs

There are three major programs that cut across all waste sectors — residential, commercial, and C&D. These are waste ban enforcement, MRIP, and recycling market development.

As discussed above, we recommend a doubling of waste ban enforcement staff from four to eight FTE to enhance a regulatory presence and motivate high levels of compliance. The MRIP program has played an important role in encouraging residential source reduction and recycling for several years. The flexibility that MRIP provides DEP in terms of adjusting eligibility criteria and payment incentives has proven to be an asset as DEP's priorities have evolved and the Department attempts to encourage municipalities to take on additional diversion activities. For example, the recent addition of a small-business recycling criterion, and increased attention on the commercial sector by MRIP coordinators have broadened MRIP's focus to the commercial sector. Therefore, MRIP is considered an overall crosscutting program.

Given MRIP's flexibility and the large increases in recycling tonnages projected through 2010, continued DEP support for MRIP is clearly warranted; the question is at what level. While we expect other tools, such as PAYT and RM, to play an increasing role in waste reduction programs across the various sectors, in order to maintain per-ton payment incentives at roughly current levels as recycling tonnages grow, we recommend gradually increasing funding for MRIP to \$5 million per year by 2010. This will ensure that MRIP continues to provide meaningful financial incentives for municipalities.

Closing the recycling loop by facilitating the development of markets for increasing levels and additional types of materials should remain a significant DEP focus. Such funding can be used in a variety of ways to support innovative technologies, research, and procurement initiatives.

As mentioned in the previous section, we recommend that DEP continue to provide strong support for the Commonwealth's Environmentally Preferable Procurement Program as a low-cost means of sending a strong signal to the marketplace. In addition to the expanded focus on toxics suggested in the HHP strategy described above, the program should continue to focus on the high-volume materials that are common in the products purchased by state and municipal government agencies. While this report is focused on recommendations for DEP programs, it is important to note that DEP's efforts in this area are complemented by the state Operational Services Division's Environmentally Preferable Purchasing program, WasteCap's Buy Recycled Business Alliance, and market development programs implemented by the Chelsea Center for Recycling and Economic Development.

The RIRC grant program is an innovative approach for promoting research and commercialization of processes to recycle new materials. The particular focus of the RIRC market development projects will likely shift over time, as markets for some materials become well established. For example, we would expect the RIRC program to focus increasingly on commercial organics and materials in the C&D waste stream, such as wood and wallboard. As the markets for the highest-quantity materials expand, and the potential tonnage impact of growing the markets for other materials is relatively low, we suggest a slow decline in support for the RIRC grants from about \$1 million in 2002 to \$700,000 in 2010.

The 2002 and recommended 2006 and 2010 costs associated with these programs are summarized below.

Cost Estimates for Overall Crosscutting Program			
	<u>2002</u>	<u>2006</u>	<u>2010</u>
Waste Ban Enforcement	\$276,000	\$483,000	\$552,000
MRIP	\$2,786,400	\$3,900,000	\$5,000,000
Waste Reduction Pilots	\$1,250,000	\$1,350,000	\$1,400,000
Recycling Market Dev. (RIRC)	\$1,000,000	\$900,000	\$700,000
Other Crosscutting Staff	\$120,000	\$138,000	\$173,000
Subtotal	\$5,432,400	\$6,771,000	\$7,825,000

J. Staffing and Budget Summary

As discussed throughout this section, in order to achieve the waste reduction goals outlined in the *Master Plan*, DEP will need significant additional staff and financial resources. These are summarized in Tables 12 and 13 below. Staffing increases are recommended primarily in overall crosscutting programs (including four additional inspectors), and in the commercial area, as the DEP's focus shifts more toward commercial waste reduction. More modest staff increases are recommended for the residential sectors (mostly for PAYT expansion) and for C&D programs. As described in previous sections of the report, 2006 and 2010 staffing and expenditure levels are not intended to be precise funding recommendations. Rather, using the

2002 expenditures and program activity levels as a starting point, they are based on professional judgment and represent the priorities and shifts in staffing and funding levels we estimate are necessary to meet the waste reduction levels identified over this period.

Table 12
2002 and Recommended 2010 Staffing Summary

	<u>2002</u>	<u>2006</u>	<u>2010</u>	<u>Change</u>
Residential Source Reduction	.25	.50	.50	.25
Residential Recycling	2.50	2.00	2.00	(.50)
Residential Composting	.25	.50	.50	.25
Residential Crosscutting	4.75	5.25	5.75	1.00
Commercial Source Reduction	.75	1.00	1.00	.25
Commercial Recycling	1.50	3.00	3.50	2.00
Commercial Composting	.75	1.50	1.50	.75
Commercial Crosscutting	.75	2.00	2.50	1.75
HHP	2.25	2.25	2.25	--
C&D	.50	1.00	1.00	.50
<u>Overall Crosscutting*</u>	<u>5.75</u>	<u>9.00</u>	<u>10.50</u>	<u>4.75</u>
Totals	20.00	28.00	31.00	11.00

* Includes waste ban inspectors.

Table 13: Budget Summary (Values shown in \$)

Sector/Program	2002	2006	2010	Change (2002-2010)
<i>Residential</i>				
PAYT	312,000	600,000	850,000	538,000
Equipment Grants	380,000	250,000	100,000	-280,000
Education/Mailings	620,000	660,000	700,000	80,000
Facility Related Grants	350,000	350,000	350,000	0
TA Grants	505,000	505,000	505,000	0
Redemption Ctr. Grants	950,000	950,000	950,000	0
Staff	535,000	575,000	615,000	80,000
<i>Residential Subtotal</i>	3,652,000	3,890,000	4,070,000	418,000
<i>Commercial</i>				
RM Contracting	50,000	200,000	100,000	50,000
Education/Mailings (Buy Recycled)	80,000	200,000	300,000	220,000
Research/Pilot Projects	70,000	250,000	350,000	280,000
TA Grants	355,000	550,000	700,000	345,000
Staff	260,000	518,000	585,000	325,000
<i>Commercial Subtotal</i>	815,000	1,718,000	2,035,000	1,220,000
<i>Crosscutting MSW</i>				
Statewide Education Campaign	1,155,000	1,250,000	1,250,000	95,000
Staff				0
<i>Crosscutting MSW Subtotal</i>	1,155,000	1,250,000	1,250,000	95,000
<i>C&D</i>				
TA Grants	77,000	100,000	100,000	23,000
RIRC Grants	277,000	280,000	280,000	3,000
Research Grants	45,000	75,000	100,000	55,000
Education		150,000	200,000	200,000
Staff	35,000	70,000	70,000	35,000
<i>C&D Subtotal</i>	434,000	675,000	750,000	316,000
<i>HHP</i>				
Equipment & Service Grants	480,000	480,000	480,000	0
Staff	155,000	155,000	155,000	0
<i>HHP Subtotal</i>	635,000	635,000	635,000	0
<i>Overall Crosscutting</i>				
Waste Ban Enforcement	276,000	483,000	552,000	276,000
MRIP	2,786,400	3,900,000	5,000,000	2,213,600
Recycling Market Development	1,000,000	900,000	700,000	-300,000
Other Crosscutting Staff	120,000	138,000	173,000	53,000
Waste Reduction Pilots	1,250,000	1,350,000	1,400,000	150,000
<i>Overall Crosscutting Subtotal</i>	5,432,400	6,771,000	7,825,000	2,392,600
Total	12,123,400	14,939,000	16,565,000	4,441,600

Figure 6: 2002 Expenditures by Sector

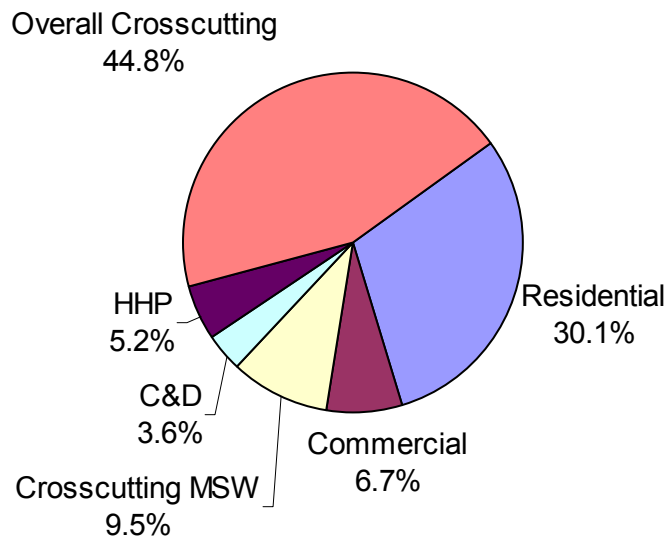
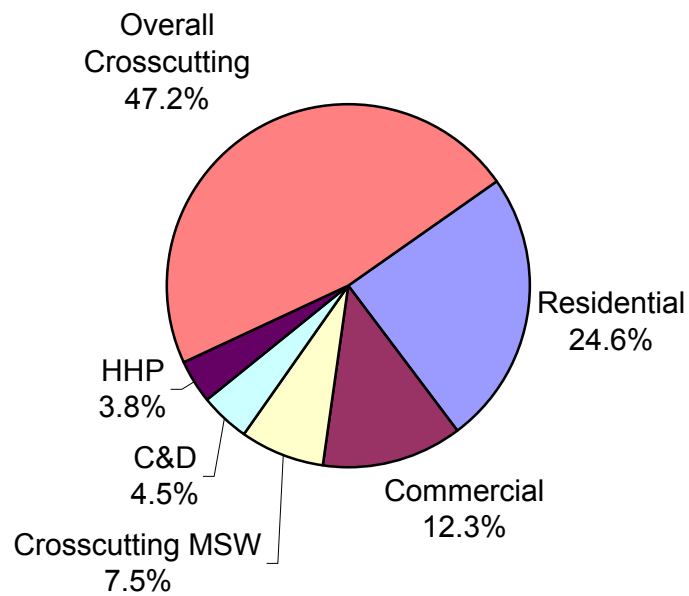


Figure 7: 2010 Expenditures by Sector



V. Improving Data and Tracking Progress

To maximize the effectiveness of its programs, it is important that DEP systematically track the impacts of its various waste reduction efforts over time. Below are Tellus' recommendations for improving existing data collection and analysis and additional data collection and evaluation strategies.

Improving Existing Data Collection and Analysis

The Department already collects a range of data on its programs, municipal waste management practices, and the facilities it regulates. Currently, DEP's major sources of data include:

- Municipal Recycling Data Sheets (MRDS)
- Compost Site Reports
- Recycling Processor Surveys
- Annual Facility Reports from Landfills, Combustion Facilities, and Transfer Stations
- Combustion Facility Material Separation Reports
- Grant Tracking Database(s)
- MRIP tonnage and program criteria documentation
- Bottle bill redemption figures from the Department of Revenue

DEP can improve its existing data sources and collection in several ways, which should help the Department make better use of this data in assessing relative contributions from different programs and inform its allocation of resources to maximize diversion effectiveness. Specific suggestions include:

- Improve municipal generation estimates. The calculated per capita waste generation rates in Appendix B of the *Beyond 2000 Master Plan* vary by more than an order of magnitude (10x) among municipalities. It is common for such generation rates to vary by factors of 2-3 times. This level of variation is unlikely to reflect reality and is a sign of potential data inconsistencies. At a minimum, DEP should spot check waste generation and management data from municipalities that is significantly divergent from average data, focusing particularly on communities with relatively large populations and waste streams. While there may be valid reasons for such divergence (e.g., high summer transient populations), such checks will help identify incorrect reporting and improve the overall validity of the data.
- The issue of data outliers in general warrants additional DEP attention. Where there are significant unexplained fluctuations in reported data (from year to year or community to community) despite consistent programmatic efforts, the Department should investigate the data and make adjustments where appropriate. In cases where there is a high level of uncertainty in the data, checking the data by using pro forma calculations with average data from historical experience or from other jurisdictions may be appropriate. Another approach to provide more consistency to highly uncertain or fluctuating data is to use multiple year averaging (over three or more years) rather than annual estimates.
- Begin to collect data on C&D composition and generation, especially from buildings, to improve DEP's understanding of this sector's waste and inform the design of C&D waste reduction programs to maximize effectiveness.

- Develop and maintain a more systematic characterization of grant programs in order to more clearly identify the waste streams and sectors each grant addresses. The categories developed in section IV, above, may be used as guidance.
- Review the existing system of waste ban inspection reports to ensure DEP is collecting data that will inform its program planning and assessment.
- Commercial sector generation and diversion data appears to be weaker than that for residential waste. This is evidenced by DEP data showing significant year-to-year fluctuation in commercial waste generation while residential waste generation data shows much more stability. While the DEP *Commercial Waste Disposal Assessment* is a valuable step towards improving the Department's understanding of the commercial waste stream and its management, DEP should focus on devising additional methods to measure or estimate waste generation and management practices.
- DEP should strive for more data and improved accountability from Recycling Loan Fund recipients in order to better track the impact of Fund-supported projects on the waste stream.
- To improve the Department's understanding of the effectiveness of its HHP efforts, all HHP collections should report on number of participating households and, if possible, average number of HHP types per household per collection.
- DEP should improve its tracking of diversion tonnage in its pilot business cooperatives as the existing data appears to be unreliable. Such tracking systems should be developed and in place prior to implementation of new pilot projects.
- The Department should continually track FTE allocations by program to ensure proper emphasis.
- The most recent version of the MRDSs (2002) no longer requests data on recycling and yard waste arrangements and costs. Such information not only provides DEP with an overview of management arrangements and costs, it can also be valuable for evaluating alternative management arrangements and municipal programs such as PAYT. DEP should consider restoring these data requests for future years' MRDSs.
- One other data discrepancy that DEP should attempt to clarify is the diversion rate for yard waste, particularly from the residential sector. While the Department has assumed a very high level of compliance with the yard waste disposal ban, this assumption is not consistent with the results of facility inspections over the past year, in which yard waste was the most frequent violation, and data from at least one community (Lexington) that implemented PAYT and saw a very large percentage increase in yard waste composting. Data from both inspections and PAYT communities' waste flow analyses are valuable "bottom-up" sources that DEP should utilize more fully.

Additional Data and Evaluation Strategies

While DEP does a reasonably good job of analyzing the data the Department collects, unfortunately the existing data sources do not allow it to easily assign costs and labor to specific program areas or strategies. We suggest that DEP follow more of a full-cost accounting approach for their own programs, which would provide better information on the allocation of costs and staff by program and strategy.

In order to measure progress towards the goal of 70% overall waste reduction by 2010 as articulated in the *Beyond 2000 Master Plan*, DEP needs to continue to examine waste

management practices at the sector level — residential, commercial, and C&D. Tracking waste diversion at this disaggregated level will allow the Department to evaluate the effectiveness of sector-based strategies such as PAYT and RM. It is important to note, however, that many programs (e.g., statewide education) remain overall crosscutting programs that cannot be tracked at the sector level.

Tracking waste reduction program effectiveness can occur in two ways: 1) general “top-down” estimates such as those DEP uses to quantify source reduction or C&D management; and 2) more specific “bottom-up” estimates derived from collecting data from program participants and management facilities. Both approaches are valid and should be utilized by the Department. The challenge is determining under what circumstances each approach is most appropriate. DEP should continue to employ a top-down approach for estimating the impacts of source reduction and other strategies where actual measurements are very difficult to develop, but it should be aware of and acknowledge the inherent level of uncertainty in such estimates.

We recommend DEP employ the more detailed bottom-up approach only for those specific sector-based programs with high waste diversion potential, such as PAYT and RM. For example, beyond the significant literature on PAYT and its general impacts on waste diversion, DEP already has a wealth of data on the specific municipalities that have implemented a PAYT system. Though there is considerable anecdotal data from some of the more than 100 communities that have adopted PAYT systems to date, DEP has not conducted a systematic analysis of the impacts on waste reduction or how PAYT’s impacts differ by community type. Specifically, DEP should refine its understanding of PAYT’s effectiveness by assessing the “before and after” waste reduction and waste disposal figures from PAYT communities. We suggest doing so for communities that have implemented PAYT for at least 2-3 years, by comparing data reported on the MRDSs for 2-3 years prior to PAYT implementation and 2-3 years after.

In addition, in order to better distinguish the impact of PAYT on communities with different characteristics (i.e. urban versus suburban, wealthy versus low-income) and waste management practices (i.e. curbside versus drop-off), DEP could analyze the data based on these characterizations.

In the case of RM contracting for commercial waste reduction, we suggest a data gathering focus on Resource Management contractors either by instituting a reporting requirement or through conducting a survey.⁴² There will be far fewer RM contractors than commercial enterprises generating waste. RM contractors should be a source of reliable data given that their contracts will include baseline waste management information for each commercial entity with which they have a contract, and their payments will be based on documented waste reduction achievements. In collecting RM related waste reduction data, DEP should include not only waste flow/disposition information, but also descriptive information on the type and size of the businesses using RM contracts. This will allow DEP to assess the effectiveness of RM on various sectors and on different size companies, which should help clarify existing questions about the

⁴² Note that due to the logistical burdens and cost considerations, at this time we do not suggest the Department institute a requirement for commercial entities to file waste reduction plans or reports on a regular basis.

suitability of RM contracting for small- and medium-sized businesses. This in turn will inform future RM program expenditures.

For bottom-up estimates, DEP should develop a measurement or tracking scheme before it implements a specific waste reduction program. For example, in order to evaluate the effectiveness of a strategy to maximize diversion of corrugated in the commercial sector the Department must first estimate existing diversion, and then measure or estimate two things: the degree to which businesses have participated in the program (i.e. its penetration rate), plus the reduction impact the program has on an average business. (Of course this could be done more precisely by sector, if necessary.) Because direct measurement is often difficult and/or expensive, the Department will likely need to develop reduction estimates with this per business or per employee approach.

Table 1: 2000 Massachusetts Residential Waste Composition, Generation, and Diversion (in tons)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Material Type	Potential Generation	Potential Generation Composition	Estimated Source Reduction	Source Reduction Rate	Actual Generation	Actual Generation Composition	Recycling & Composting Diversion	Recycling/Composting Diversion Rate	Disposal Tonnages	Disposal Composition	Total Diversion, w/ SR	Total Diversion Rate
Corrugated	117,200	2.7%	27,531	23.5%	89,670	2.9%	13,037	14.5%	76,633	3.3%	40,567	34.6%
Mixed Paper	775,733	18.1%	76,848	9.9%	698,885	22.3%	198,299	28.4%	500,586	21.6%	275,147	35.5%
Newspaper	227,157	5.3%	30,661	13.5%	196,496	6.3%	54,354	27.7%	142,142	6.1%	85,015	37.4%
Glass	231,013	5.4%	45,362	19.6%	185,652	5.9%	101,603	54.7%	84,049	3.6%	146,964	63.6%
Plastic	263,789	6.2%	6,954	2.6%	256,835	8.2%	19,520	7.6%	237,315	10.2%	26,474	10.0%
Aluminum	33,772	0.8%	5,957	17.6%	27,815	0.9%	17,927	64.5%	9,888	0.4%	23,884	70.7%
Steel/Tin Cans	52,665	1.2%	9,496	18.0%	43,169	1.4%	14,741	34.1%	28,428	1.2%	24,237	46.0%
Scrap Metal	121,883	2.8%	20,202	16.6%	101,681	3.3%	29,992	29.5%	71,689	3.1%	50,194	41.2%
White Goods	21,928	0.5%	5,441	24.8%	16,486	0.5%	16,486	100.0%	0	0.0%	21,928	100.0%
Food	719,136	16.8%	323,611	45.0%	395,525	12.6%	0	0.0%	395,525	17.0%	323,611	45.0%
Yard Waste	1,090,375	25.4%	550,000	50.4%	540,375	17.3%	335,197	62.0%	205,178	8.8%	885,197	81.2%
HHP	10,662	0.2%	0	0.0%	10,662	0.3%	774	7.3%	9,888	0.4%	774	7.3%
Other Materials	622,447	14.5%	57,938	9.3%	564,509	18.0%	5,830	1.0%	558,679	24.1%	63,768	10.2%
Totals	4,287,760	100.0%	1,160,000	27.1%	3,127,759	100.0%	807,759	25.8%	2,320,000	100.0%	1,967,760	45.9%

- 1) Potential Generation (a) equals Estimated Source Reduction (c) + Recycling & Composting Diversion (g) + Disposal Tonnages (i).
- 2) Estimated Source Reduction (c) tonnage total from *2000 Progress Report* and allocated across materials using Massachusetts and national EPA estimates.
- 3) Actual Generation (e) equals Recycling & Composting Diversion (g) + Disposal Tonnages (i).
- 4) Recycling & Composting Diversion (g) tonnages from DEP data.
- 5) Recycling & Composting Diversion Rate (h) equals Recycling & Composting Diversion (g) divided by Actual Generation (e).
- 6) Disposal Tonnages (i) total from *2000 Progress Report*, distributed across materials using Disposal Composition (j).
- 7) Disposal Composition (j) developed using disposal compositions in other states and professional judgment.
- 8) Total Diversion w/ SR (k) equals Estimated Source Reduction (c) + Recycling & Composting Diversion (g).
- 9) Total Diversion Rate (l) equals Total Diversion w/ SR (k) divided by Potential Generation (a).
- 10) Other Materials include ash, batteries, bulky items, carpet, computer equipment/peripherals, diapers, electric and electronic products, empty HHP containers, household bulky items, miscellaneous, mixed residue, textiles, tires, remainder/composite/other organic material, remainder/composite special waste, and rubber.

Table 2: 2010 “Base Case” Residential Waste Composition, Generation, and Diversion (in tons)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Material Type	Potential Generation	Potential Generation Composition	Estimated Source Reduction	Source Reduction Rate	Actual Generation	Actual Generation Composition	Recycling & Composting Diversion	Recycling/Composting Diversion Rate	Disposal Tonnages	Disposal Composition	Total Diversion, w/ SR	Total Diversion Rate
Corrugated	150,536	2.7%	35,361	23.5%	115,175	2.9%	16,745	14.5%	98,430	3.3%	52,106	34.6%
Mixed Paper	996,378	18.1%	98,706	9.9%	897,672	22.3%	254,702	28.4%	642,970	21.6%	353,408	35.5%
Newspaper	291,768	5.3%	39,382	13.5%	252,386	6.3%	69,814	27.7%	182,572	6.1%	109,196	37.4%
Glass	296,721	5.4%	58,264	19.6%	238,457	5.9%	130,502	54.7%	107,955	3.6%	188,766	63.6%
Plastic	338,820	6.2%	8,932	2.6%	329,888	8.2%	25,072	7.6%	304,815	10.2%	34,004	10.0%
Aluminum	43,378	0.8%	7,652	17.6%	35,726	0.9%	23,026	64.5%	12,701	0.4%	30,677	70.7%
Steel/Tin Cans	67,645	1.2%	12,197	18.0%	55,448	1.4%	18,934	34.1%	36,514	1.2%	31,130	46.0%
Scrap Metal	156,550	2.8%	25,948	16.6%	130,602	3.3%	38,523	29.5%	92,080	3.1%	64,471	41.2%
White Goods	28,165	0.5%	6,989	24.8%	21,176	0.5%	21,176	100.0%	0	0.0%	28,165	100.0%
Food	923,683	16.8%	415,657	45.0%	508,026	12.6%	0	0.0%	508,026	17.0%	415,657	45.0%
Yard Waste	1,400,516	25.4%	706,439	50.4%	694,077	17.3%	430,539	62.0%	263,538	8.8%	1,136,978	81.2%
HHP	13,694	0.2%	0	0.0%	13,694	0.3%	994	7.3%	12,701	0.4%	994	7.3%
Other Materials	799,492	14.5%	74,418	9.3%	725,074	18.0%	7,488	1.0%	717,586	24.1%	81,906	10.2%
Totals	5,507,346	100.0%	1,489,944	27.1%	4,017,402	100.0%	1,037,514	25.8%	2,979,888	100.0%	2,527,458	45.9%

Notes:

- 1) Potential Generation Composition (b), Source Reduction Rate (d), Actual Generation Composition (f), Recycling/Composting Diversion Rate (h), Disposal Composition (j), and Total Diversion Rate (l) remain as on Table 1.
- 2) Potential Generation (a) tonnage total equals total on Table 1 column (a) increased using estimated growth in GSP from 2000 to 2010 (factor = 1.284).
- 3) Estimated Source Reduction (c) equals Potential Generation (a) times Source Reduction Rate (d).
- 4) Recycling & Composting Diversion (g) equals Actual Generation (e) times Recycling/Composting Diversion Rate (h).

Table 3: 2010 Residential Recycling / Composting Diversion Potential (in tons)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Material Type	Actual Generation	Technical R/C Potential	Realistic R/C Potential	Realistic Potential R/C Diversion	Additional Potential Diversion	Total Potential Diversion w/ SR	Potential Total Diversion Rate
Corrugated	115,175	98%	50%	56,436	51,230	91,797	61.0%
Mixed Paper	897,672	98%	60%	527,831	351,390	626,537	62.9%
Newspaper	252,386	98%	80%	197,871	152,237	237,252	81.3%
Glass	238,457	95%	70%	158,574	69,874	216,838	73.1%
Plastic	329,888	90%	25%	74,225	56,683	83,157	24.5%
Aluminum	35,726	95%	80%	27,152	10,920	34,804	80.2%
Steel/Tin Cans	55,448	95%	60%	31,605	19,565	43,802	64.8%
Scrap Metal	130,602	90%	55%	64,648	40,402	90,596	57.9%
White Goods	21,176	80%	100%	21,176	6,237	28,165	100.0%
Food	508,026	98%	10%	49,787	141,833	465,444	50.4%
Yard Waste	694,077	99%	90%	618,423	439,664	1,324,861	94.6%
HHP	13,694	70%	25%	2,397	1,623	2,397	17.5%
Other Materials	725,074	70%	25%	126,888	137,538	201,306	25.2%
Totals	4,017,402		49%	1,957,011	1,479,196	3,446,956	62.6%

Notes:

- 1) Technical Potential (b) represents the portion of waste stream that could technically be diverted.
- 2) Realistic Potential (c) estimates the realistic potential diversion of each material independent of its technical limitations.
- 3) Realistic Potential Diversion (d) equals Actual Generation ((e) from Table 2) multiplied by (b) times (c).
- 4) Additional Potential Diversion (e) equals Total Potential Diversion (f) minus Total Diversion (k) in Table 1 (year 2000).
- 5) Total Potential Diversion (f) adds Source Reduction ((c) from Table 2) to (d).
- 6) Assumes that white goods recycling remains at existing levels.

Table 4: 2000 Massachusetts Commercial Waste Composition, Generation and Diversion (in tons)

	(a)	(b)	(c)	(d)	(e)	(f)
Material Type	Actual Generation	Generation Composition	Recycling & Composting Diversion	Recycling & Composting Diversion Rate	Disposed Tonnages	Disposal Composition
Corrugated	625,575	12.9%	409,126	65.4%	216,449	7.3%
Mixed Paper	1,253,029	25.8%	449,837	35.9%	803,192	27.0%
Newspaper	203,820	4.2%	102,725	50.4%	101,095	3.4%
Glass	265,482	5.5%	171,236	64.5%	94,246	3.2%
Plastics	321,070	6.6%	13,806	4.3%	307,264	10.3%
Aluminum	9,617	0.2%	4,328	45.0%	5,289	0.2%
Steel/Tin Cans	62,741	1.3%	35,888	57.2%	26,853	0.9%
Scrap Metal	294,486	6.1%	127,218	43.2%	167,268	5.6%
White Goods	6,146	0.1%	3,380	55.0%	2,766	0.1%
Food	628,366	12.9%	25,135	4.0%	603,231	20.3%
Yard Waste	460,392	9.5%	227,894	49.5%	232,498	7.8%
HHP	12,502	0.3%	4,376	35.0%	8,126	0.3%
Other Materials	717,525	14.8%	315,711	44.0%	401,814	13.5%
Totals	4,860,750	100.0%	1,890,659	38.9%	2,970,090	100.0%

Notes:

- 1) Consistent with the Beyond 2000 Master Plan, no commercial source reduction is assumed for 2000.
- 2) Actual Generation (a) equals Disposal Tonnages (e) divided by (1 minus Recycling & Composting Diversion Rate (d)).
- 3) Generation Composition (b) equals Actual Generation (a) of each material divided by total Actual Generation.
- 4) Recycling & Composting Diversion (c) equals Recycling & Composting Diversion Rate (d) x Actual Generation (a). Note that these tonnages were checked against DEP's Commercial Processor Survey control totals.
- 5) Recycling & Composting Diversion Rate (d) derived from DEP Commercial Processor Survey data, plus professional judgment regarding organics, white goods, HHP, and other materials.
- 6) Composition of the Disposal Tonnages (e) derived from applying the Disposal Composition (f) from the *Massachusetts Commercial Waste Disposal Assessment*, November 2002, to the total disposal tonnages from the *Master Plan*.

Table 5: 2010 “Base Case” Commercial Waste Generation and Diversion (in tons)

Material Type	(a)	(b)	(c)	(d)	(e)	(f)
	Actual Generation	Generation Composition	Recycling & Composting Diversion	Recycling & Composting Diversion Rate	Disposal Tonnages	Disposal Composition
Corrugated	803,488	12.9%	525,481	65.4%	278,007	7.3%
Mixed Paper	1,609,391	25.8%	577,771	35.9%	1,031,619	27.0%
Newspaper	261,786	4.2%	131,678	50.3%	130,108	3.4%
Glass	340,985	5.5%	219,935	64.5%	121,050	3.2%
Plastics	412,382	6.6%	17,732	4.3%	394,650	10.3%
Aluminum	12,352	0.2%	5,558	45.0%	6,794	0.2%
Steel/Tin Cans	80,584	1.3%	46,094	57.2%	34,490	0.9%
Scrap Metal	378,237	6.1%	163,399	43.2%	214,839	5.6%
White Goods	7,894	0.1%	4,342	55.0%	3,552	0.1%
Food	807,073	12.9%	32,283	4.0%	774,790	20.3%
Yard Waste	591,327	9.6%	295,664	50.0%	295,664	7.8%
HHP	16,057	0.3%	5,620	35.0%	10,437	0.3%
Other Materials	921,589	14.7%	405,499	44.0%	516,090	13.5%
Totals	6,243,147	100.0%	2,431,058	38.9%	3,812,089	100.0%

Notes:

- 1) All notes from Table 4 apply; also, all figures are multiplied by 1.284, which is the expected change in the Gross State Product (GSP) through 2010.

Table 6: 2010 Commercial Waste Generation and Diversion Potential (in tons)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Material Type	Potential Generation	Estimated Source Reduction Rate	Estimated Source Reduction	Actual Generation	Technical Potential	Realistic Potential	Estimated Realistic Recycling/Composting	Total Potential Diversion	Overall Diversion Rate (w/SR)	Additional Potential Diversion
Corrugated	803,488	25%	200,872	602,616	98%	85%	501,979	702,851	87%	293,725
Mixed Paper	1,609,391	20%	321,878	1,287,512	98%	60%	757,057	1,078,935	67%	629,098
Newspaper	261,786	10%	26,179	235,608	98%	80%	184,716	210,895	81%	108,170
Glass	340,985	15%	51,148	289,837	95%	65%	178,975	230,122	67%	58,886
Plastics	412,382	10%	41,238	371,144	90%	40%	133,612	174,850	42%	161,044
Aluminum	12,352	0%	0	12,352	95%	80%	9,387	9,387	76%	5,060
Steel/Tin Cans	80,584	0%	0	80,584	98%	80%	63,178	63,178	78%	27,290
Scrap Metal	378,237	0%	0	378,237	90%	80%	272,331	272,331	72%	145,113
White Goods	7,894	20%	1,579	6,315	98%	90%	5,570	7,149	91%	3,768
Food	807,073	15%	121,061	686,012	98%	35%	235,302	356,363	44%	331,228
Yard Waste	591,327	20%	118,265	473,062	99%	90%	421,498	539,764	91%	311,870
HHP	16,057	20%	3,211	12,846	70%	50%	4,496	7,708	48%	3,332
Other Materials	921,589	5%	46,079	875,510	70%	65%	398,357	444,436	48%	128,725
Totals	6,243,147		931,511	5,311,636			3,166,459	4,097,970	66%	2,207,311

Notes:

- 1) Potential Generation (a) equals 2000 Actual Generation ((a) from Table 4) multiplied by the expected growth in Gross State Product (1.284).
- 2) Estimated Source Reduction Rate (b) and Source Reduction Tonnage (c) derived from DEP's *2000 Progress Report*, allocated by material based on national experience and professional judgment.
- 3) Actual Generation (d) equals Potential Generation (a) minus Estimated Source Reduction (c).
- 4) Technical Potential (e) represents the portion of the waste stream that it is technically feasible to divert from disposal.
- 5) Realistic Potential (f) is estimated based on experience of most successful programs nationally and professional judgment.
- 6) Estimated Realistic Recycling/Composting (g) equals Actual Generation (d) multiplied by Technical Potential (e) times Realistic Potential (f).
- 7) Total Potential Diversion (h) equals Estimated Source Reduction (c) plus Estimated Realistic Recycling/Composting (g).
- 8) Overall Diversion Rate (w/SR) (i) equals the sum of Estimated Realistic Recycling/Composting (g) plus Estimated Source Reduction tonnage (c), divided by Potential Generation (a).
- 9) Additional Potential Diversion (j) equals Total Potential Diversion (h) minus Recycling & Composting Diversion (c) from 2000 in Table 4.

Table 7: 2000 C&D Waste Generation and Diversion (in tons)

	(a)	(b)	(c)	(d)
Material Type	Actual Generation	Calculated Recycling Rate	Recycled	Disposed (& Exported)
ABC	3,635,998	90%	3,290,000	345,998
Wood	366,927	16%	60,000	306,927
Metal	99,400	70%	70,000	29,400
Gypsum Wallboard	79,045	0%	0	79,045
Roofing	87,749	0%	0	87,749
Plastic	1,289	0%	0	1,289
Corrugated	2,418	0%	0	2,418
Other	207,174	39%	80,000	127,174
Subtotal	4,480,000	78%	3,500,000	980,000
Source Reduction	470,000			
Total Potential Generation & Overall Waste Reduction Rate	4,950,000	80%		

Notes:

- 1) Actual Generation (a) equals Recycled (c) plus Disposed (& Exported) (d).
- 2) Calculated Recycling Rate (b) equals Recycled (c) divided by Actual Generation (a).
- 3) Recycled (c) from *2000 Progress Report*.
- 4) Disposed (& Exported) (d) assumes that all remaining C&D waste is building-related and allocated according to average composition in EPA 1998 C&D report.
- 5) Source Reduction estimate from *2000 Progress Report*, p. 13.
- 6) Overall Waste Reduction equals Recycling plus Source Reduction divided by Total Potential Generation.

Table 8: 2010 C&D Waste Generation and Diversion (in tons)

Material Type	(a)	(b)	(c)	(d)
	Projected Generation	Calculated Recycling Rate	Projected Recycled	Disposed (& Exported)
ABC	4,668,621	95%	4,435,190	233,431
Wood	471,134	70%	329,794	141,340
Metal	127,630	80%	102,104	25,526
Gypsum Wallboard	101,493	50%	50,747	50,747
Roofing	112,669	50%	56,335	56,335
Plastic	1,656	0%	0	1,656
Corrugated	3,104	50%	1,552	1,552
Other	266,012	30%	79,804	186,208
Subtotal	5,752,320	88%	5,055,525	696,795
Source Reduction	600,000			
Total Potential Generation & Overall Waste Reduction Rate	6,352,320	89%		

Notes:

- 1) Projected Generation (a) equals 2000 Actual Generation ((a) from Table 7) increased by the expected change in GSP (1.284).
- 2) Calculated Recycling Rate (b) equals Projected Recycled (c) divided by Actual Generation ((a) from Table 7).
- 3) Projected Recycled (c) based on *2000 Progress Report*, adjusted by assumed realistic recycling rates in (b).
- 4) Disposed (& Exported) (d) equals Projected Generation (a) minus Projected Recycled (c).
- 5) Source Reduction estimate from *2000 Progress Report*, p. 13, increased by the growth in GSP (1.284).
- 6) Overall Waste Reduction equals Projected Recycled (c) plus Source Reduction, divided by Total Projected Generation.

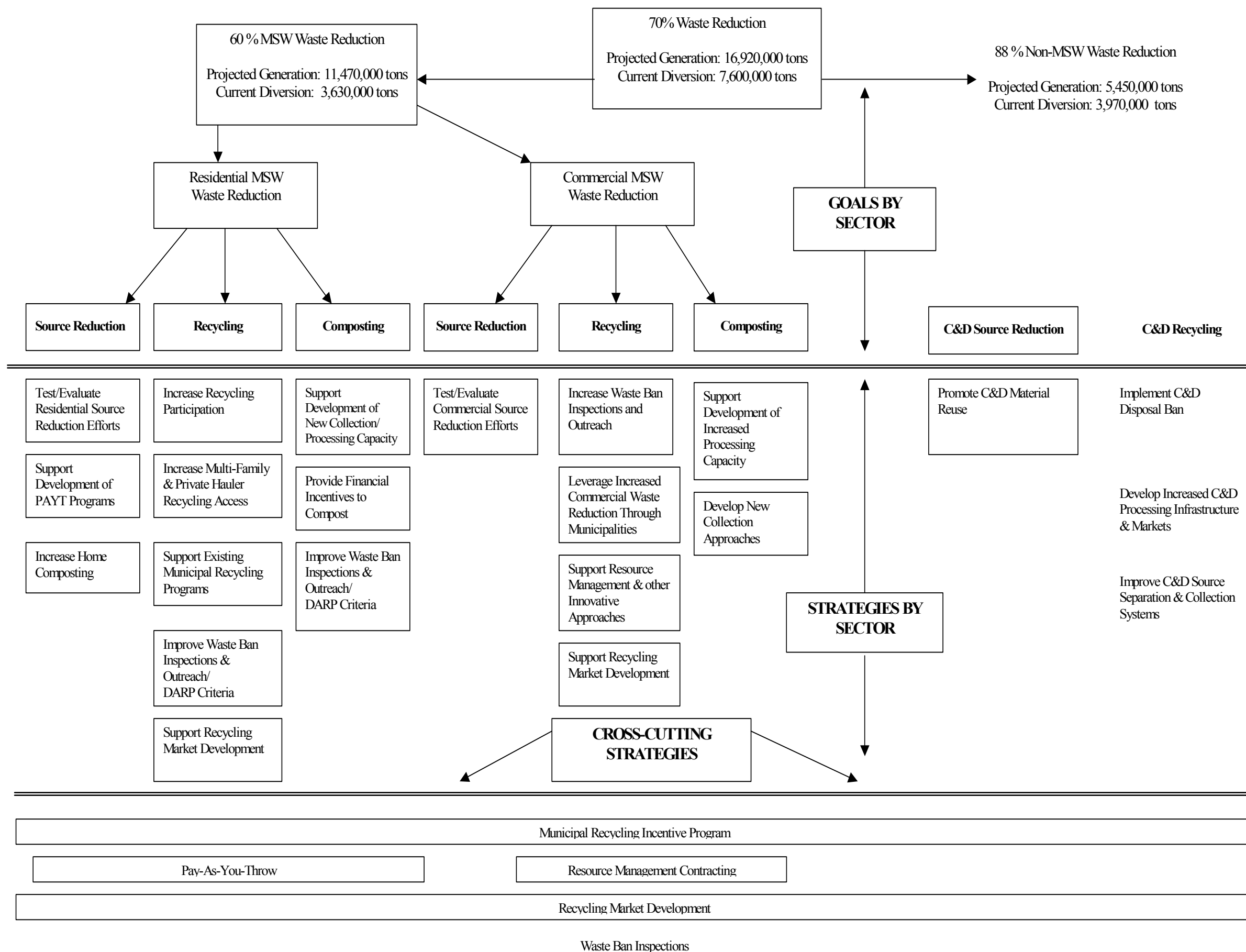


Figure 5: DEP Waste Reduction Strategies

